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METAL INDUSTRY

THE JOURNAL OF NON-FERROUS METALS

VOL 98 No 25 ONE SHILLING

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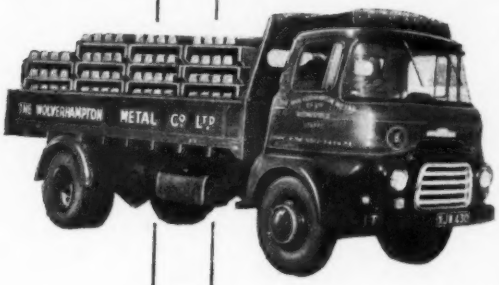

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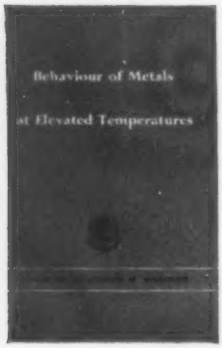

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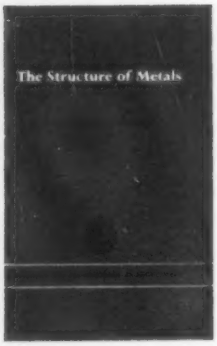

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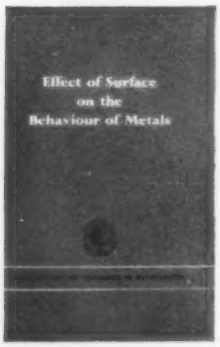

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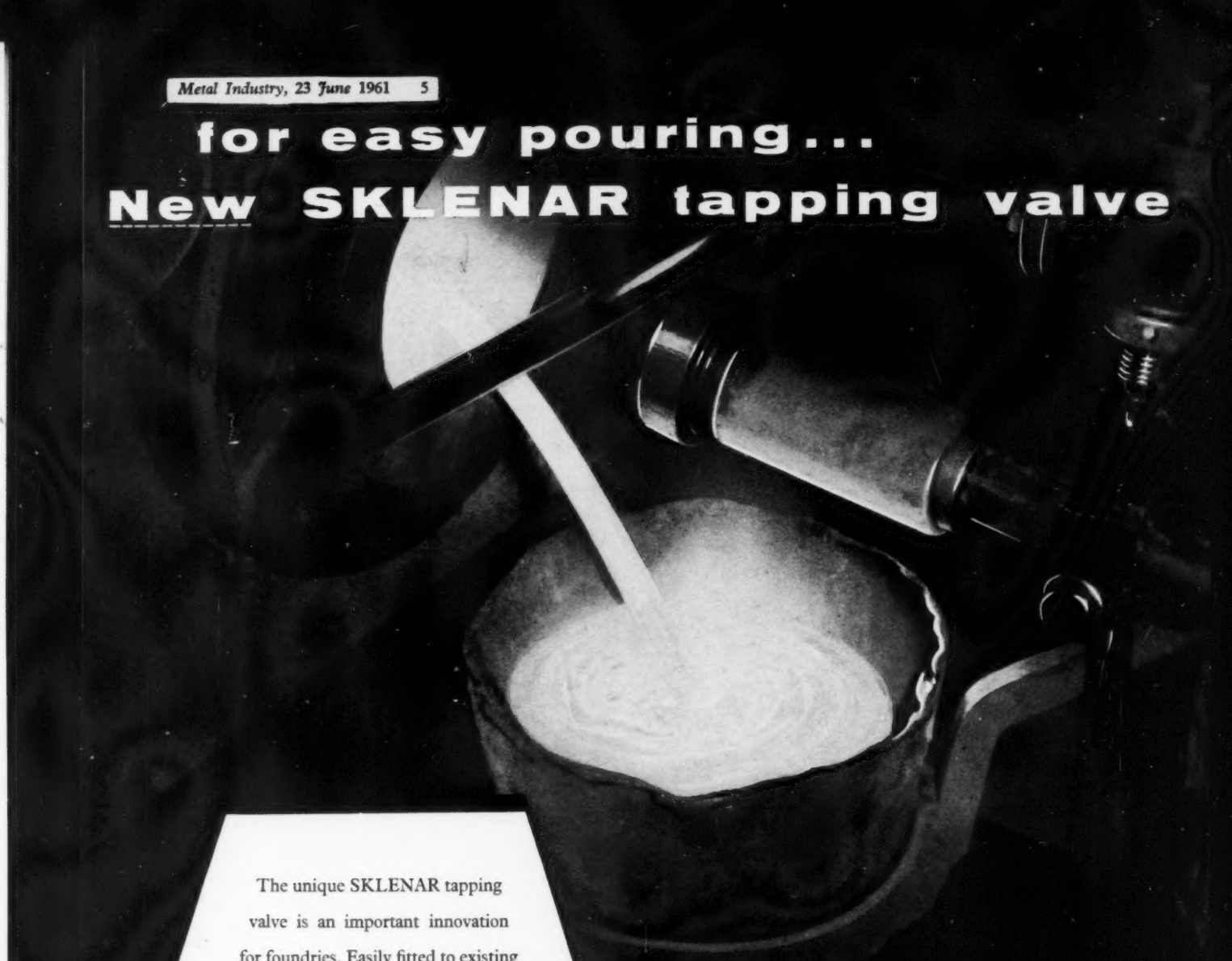

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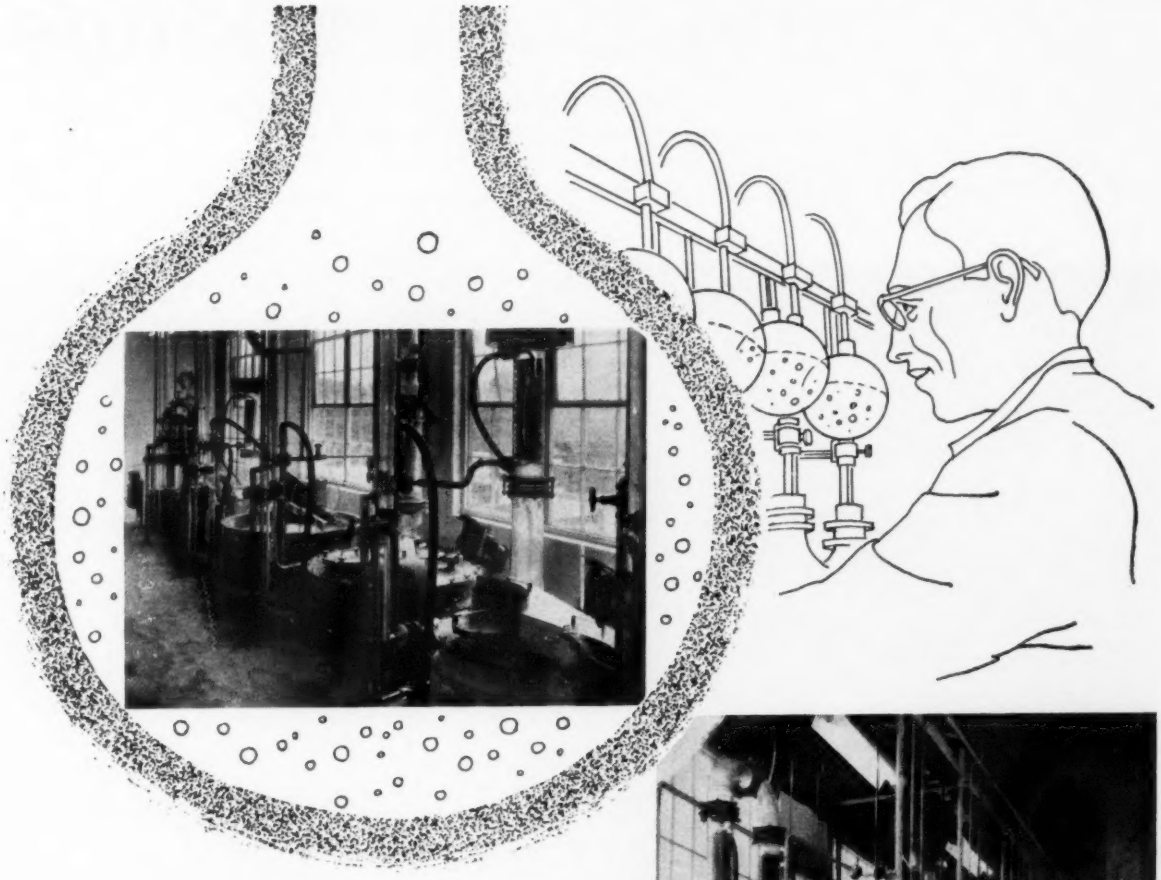

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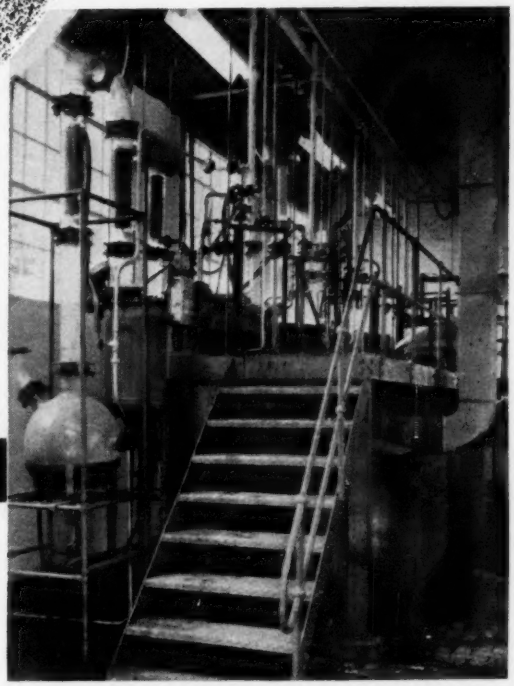

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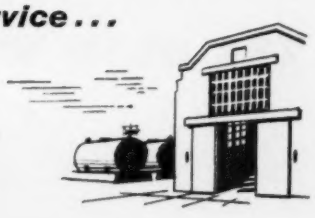

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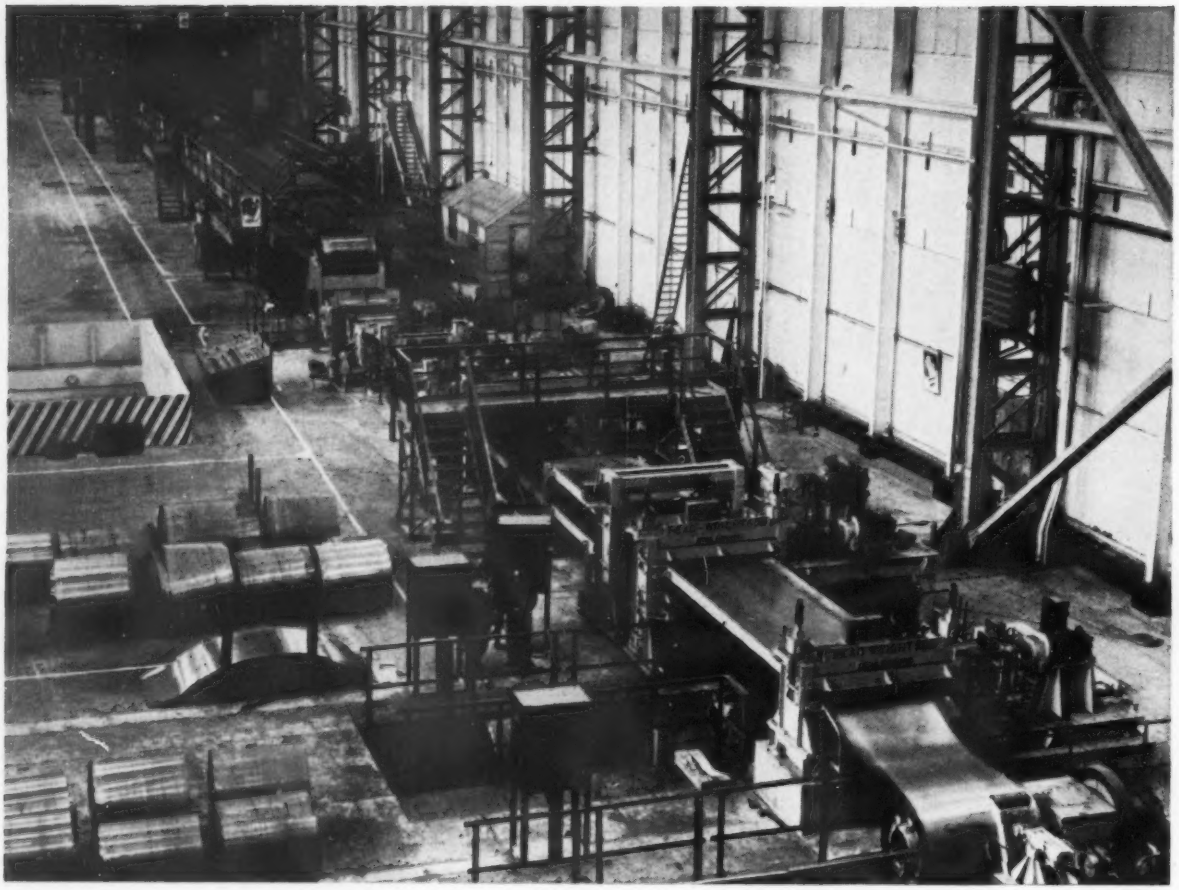

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23 JUNE 1961 VOLUME 98 NUMBER 25

CONTENTS

PUBLISHED EVERY FRIDAY BY ILIFFE PRODUCTION PUBLICATIONS LTD.

Editorial Offices: 9 Charlotte Street, Birmingham 3. Telephone: Central 3206

Advertising and Publishing Offices: Dorset House, Stamford Street, London, S.E.1. Tel.: Waterloo 3333. 'Grams: "Metustry, London-S.E.1"

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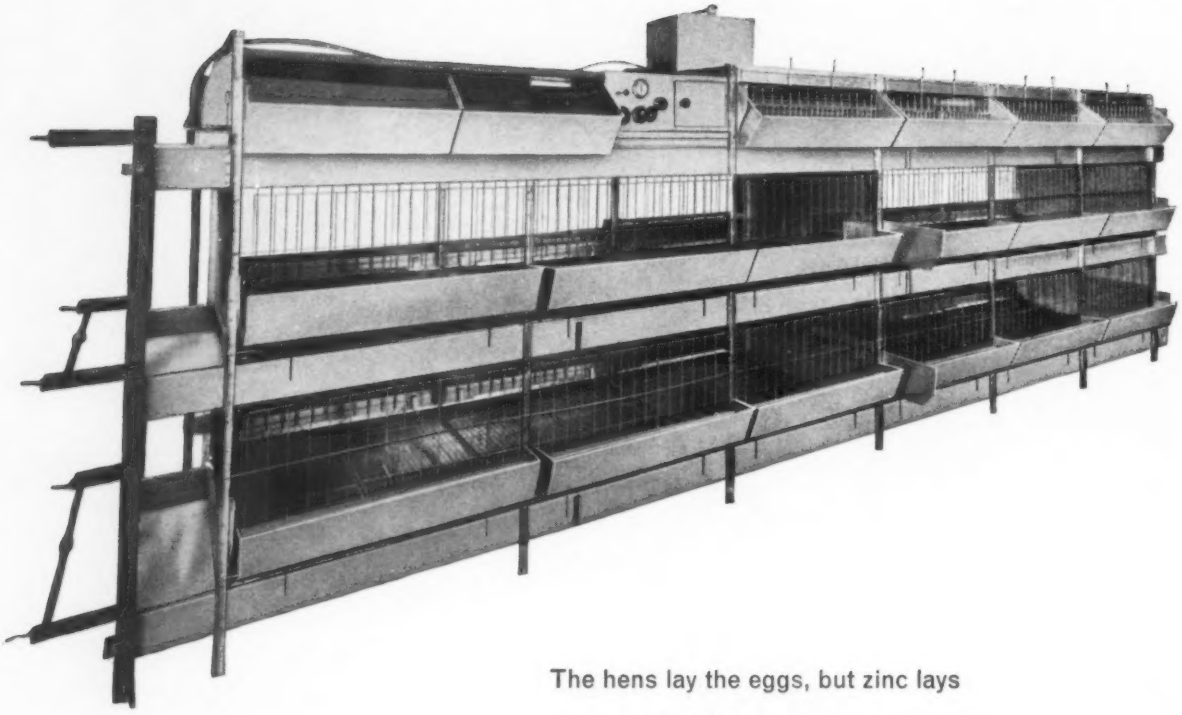

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METAL INDUSTRY

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Hot Dip Galvanizing

NOTHING succeeds like success. The continued growth of international galvanizing conferences from the modest start eleven years ago in Copenhagen to that at Interlaken, reported in this issue, which was attended by some four hundred delegates from twenty countries, is proof of this. This growth is indicative of the expanding use of galvanized products in the industrial world and of the interest taken by galvanizers in the betterment of their products and processes. Such conferences, with their technical sessions, undoubtedly contribute much to the art and science of galvanizing, and help to maintain its position in this competitive world. But, as Mr. J. L. Kimberley, of the American Zinc Institute, pointed out at the final session, one phase of the problem had been barely touched upon—namely, the commercial question of ensuring a continued demand for their goods and services.

Quoting, as was only natural, from American sources, Mr. Kimberley claimed that competitors from aluminium, aluminium-coated steel and plastics had gone further in their effort to encroach on markets for zinc and galvanized steel than had their European counterparts—a state of affairs which galvanizers in Europe could not treat complacently. The aluminium industry in the U.S.A. is currently spending $65,000,000 a year on market development, advertising and general promotion. One company alone is reported to have spent $45,000,000 to date in the development of a new plastics material—and this market development is still very young. This search for markets for new materials is, of course, not confined to the replacement of galvanized products. Many galvanized products are, however, under attack, particularly holloware, nuts and bolts, pipe, sheet, wire and sections. Confirmation that similar competition was being met with in Europe, though admittedly as yet not on such a large scale, came from a German delegate.

Present steps that are being taken in the United States to meet this challenge include an expenditure in 1961 by the American zinc producers on the work of the American Zinc Institute three times that of 1958. This work covers both research and promotional activities. Many individual companies have also expanded their advertising and personal sales effort. Mr. Kimberley did not presume to suggest in detail how European commercial methods might be altered to meet the developing competition, but he did sincerely recommend a re-examination of present methods in order that they might be made more effective. It was for each individual company to decide whether to advertise more, to expand its personal and direct sales effort, enlarge its technical services to customers and prospective customers, or strengthen its promotional efforts through the national and international organizations such as the Zinc Development Association or the European General Galvanizers' Association.

Details of the research programme currently being undertaken by the American Zinc Institute were outlined by Dr. S. Radtke, who emphasized that it was an international programme. This information was disseminated in two ways, by quarterly technical abstracts available to all and by quarterly reports available to member companies or through the Zinc Development Association. Present plans for the Hot Dip Galvanizers Association were revealed by Mr. R. Lewis Stubbs, who said that they were conducting an advertising campaign on the slogan "Steel need not rust", and that next year this would be based on the "Fe + Zn" symbols used in the present Conference. Publications dealing with galvanizing in different industries, with the galvanizing process and with the corrosion resistance of galvanized coatings were also available, and a new Bulletin illustrating the achievements of galvanizing would be published bi-yearly.

Out of the MELTING POT

Demodifying Factor

BELATED interest in hyper-eutectic aluminium-silicon casting alloys has stimulated a good deal of research on the modification of these alloys. The well-known sodium and flux modification treatments so successful in the case of the eutectic aluminium-silicon alloys are ineffective with alloys containing larger amounts of silicon, of the order of 20 per cent or more. At the same time, these hyper-eutectic aluminium-silicon alloys, in the modified, as-cast condition, have a coarse structure characterized by low strength and poor machining characteristics. This problem, to which the above-mentioned belated interest in these alloys is undoubtedly partly due, was solved some time ago by the discovery of the modifying effect upon them of phosphorus. Various methods of introducing this element—as such, in the form of copper phosphide, or by way of thermite type reaction mixtures—have since been suggested. It is generally assumed that the introduction of phosphorus by one or other of these methods leads to the formation of aluminium phosphide, which is regarded as being the active agent causing the refining of the primary silicon. The effect of such a treatment is gradually lost when the alloy is held in the molten state at 850°-880°C. Loss of modification after 1½ to 3 hr. can then be reversed by treating the melt with chlorine (e.g. by adding manganese chloride). This demodification on holding has hitherto been thought to be due to the appearance in the molten alloy of sodium, the remodification by chlorination being explained by the removal of the sodium. A different explanation has been suggested by experiments with aluminium-24 per cent silicon alloy, in which it was found that loss of modification was brought about by gassing (blowing of the melt with steam or dry nitrogen). Apart from the resulting loss of modification, it was also found that such gassing, applied to the unmodified alloy, interfered with any subsequent modification treatment. In all cases, the effects were eliminated, and modification was restored, by treatment with manganese chloride. It was also found that the effects of gassing could be reversed by exposing the melt for some time to a vacuum, and that, moreover, no loss of modification occurred in melts held in a vacuum for periods of up to 3½ hr. Coarsening of the structure of the modified alloy must therefore be ascribed to the presence of dissolved gas.

Not Impossible

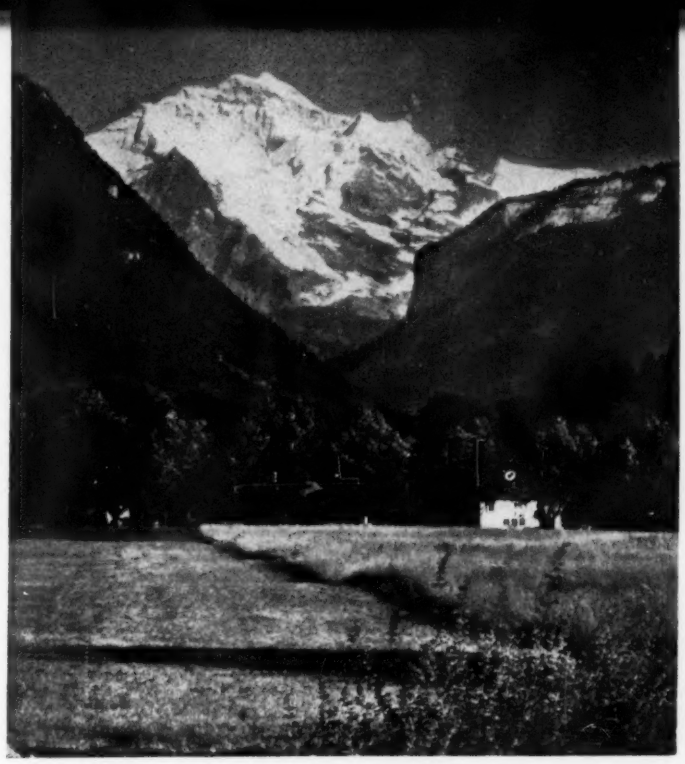
ONE of the claims traditionally made for powder metallurgy is that it enables the production of compositions which it would be difficult or impossible to obtain by the usual procedure of melting, casting, and hot and cold working. While this claim is reasonably justified, there are, nevertheless, instances of compositions, the production of which by the usual procedure of pressing and sintering is difficult or impossible. A case in point is the production of copper-cadmium or silver-cadmium alloys with from 0·1 to 30 per cent cadmium, the difficulty here arising through the considerable loss of cadmium by volatilization during sintering. This need not mean, however, that powder metallurgy has to be abandoned in such cases: suitable additional provisions may help to avoid the difficulty. Thus, in the case of copper-cadmium and silver-cadmium alloys, the usual practice of mixing the metal powders in the required proportions and then cold compacting the mixture to the required density can be retained. For sintering, however, the compacts should be packed in a mixture of aluminium oxide or titanium dioxide with 1 to 20 per cent cadmium oxide or 0·5 to 10 per cent cadmium powder. The exact proportion of the cadmium constituent must be determined experimentally. Sintering is carried out in an autoclave in an atmosphere of argon, which during heating up, sintering and cooling of the compacts should be maintained at a pressure of from 3 to 150 atm. A pressure of between 5 and 25 atm., for example, is effective in completely suppressing losses of cadmium when sintering, at 800°C., copper or silver compacts containing 1 per cent of cadmium, the compacts being packed for sintering in a mixture of 98·5 per cent aluminium oxide and 1·5 per cent cadmium oxide.

By Force

MANY and varied are the methods adopted to ensure that coatings applied to the surface of metals adhere strongly to such surfaces and do not become detached and flake off in service. Familiar methods include the various forms of mechanical, chemical and electrochemical preparation of the surfaces to be coated, and the heat-treatment of coated parts to improve adhesion of the coatings, e.g. as a result of interdiffusion in the case of metallic coatings. An unusual final step — adopted originally, one feels, in desperation—has been suggested as an improvement in the process of aluminizing poppet valves, turbine blades and similar parts requiring protection against the effects of operation at high temperatures. The usual procedure involves the application of aluminium to the poppet valves by dipping or spraying. The valves are then heated in an oxidizing atmosphere to cause diffusion of some of the aluminium into the basis metal and the oxidation of the remainder to form a heat-resisting protective surface film of aluminium oxide. Unfortunately, the adhesion of this oxide film is not very good. Another complication is that the above treatment may cause dimensional changes and distortion of the parts which it is then impossible to rectify by machining. Adopting a desperate measure, adhesion of the coating is ensured by literally knocking it into the surface. This is effected by heating the coated parts to the forging temperature and, after diffusion and oxidation of the aluminium have occurred, subjecting the parts to a forging operation, whereby the surface oxide film is disintegrated and impressed into the surface consisting of iron and diffused aluminium. This forging operation may also serve to bring the parts to their finished shape. Indeed, one suspects that, in the first instance, the breaking up of the surface oxide film and its impression into the surface were discovered as useful concomitants of the forging of the parts to the required dimensions and shape after the diffusion heat-treatment.

Skimmer

Sixth International Galvanizing Conference



INTERLAKEN provided a perfect setting for the Sixth International Galvanizing Conference held there during the week beginning June 4. Organized by the Zinc Development Association and the Swiss General Galvanizers' Association on behalf of the European General Galvanizers' Association, the Conference was attended by some four hundred delegates from twenty countries. They and their ladies attended a reception given by the Swiss Galvanizers' Association on Sunday June 4 at the Grand Hotel Victoria Jungfrau, when they were welcomed by **Mr. A. Pezolt,** Secretary of the Association and **Mr. Max Brodbeck,** President of the E.G.G.A.

On the morning of Monday, June 5, the Conference was formally opened by Mr. Max Brodbeck and **Mr. R. Gloor** (President of the Swiss Galvanizing Association) in the presence of the Burgomaster of Interlaken, at the Kursaal. After welcoming the delegates Mr. Brodbeck referred to the death of Dr. Heinz Bablik, and announced that arrangements were being made to collect his publications and publish them as a complete work, in remembrance of one who had made the subject of galvanizing his life's work.

During the week nine technical sessions were held during which twenty-six Papers on general, sheet and wire galvanizing, were discussed. A tenth session took the form of a "questions and answers" period when the delegates exchanged views on various aspects of galvanizing and films were shown. In addition there were held three informal discussion groups on labour management and welfare, plant layout, and costing and management. Wednesday and Thursday were devoted to visits to a number of works in Switzerland and Italy. Descriptions of some of these works are included in this issue.

An attractive programme had been arranged for the entertainment of the ladies and the Conference ended on the evening of Friday, June 9, with a banquet at the Grand Hotel Victoria Jungfrau by invitation of the Swiss Galvanizers' Association followed by an entertainment and dancing at the Kursaal.

Applications of Galvanizing

The first technical session, under the chairmanship of **Mr. R. Gloor,** was devoted to a discussion of a Paper entitled "Survey of Practice and Applications of Galvanized Steel," by E. G. C. Green and M. H. Davies, an abstract of which is published below.

In the discussion **Mr. C. Origoni** (Italy) pointed out that Table V in the Paper enabled a comparison to be made of zinc losses in the wet and dry galvanizing processes. In

Survey of Practice and Applications of Galvanized Steel

By E. G. C. GREEN and M. H. DAVIES

THE original intention of the present survey was to concentrate on applications for galvanized steel, and galvanizers were asked to record the nature of the material processed (with regard to the type of article, section, or fabrication and also its end-use) over a three-month period. Returns were made by 37 firms.

The total tonnage processed in the 18 German galvanizing plants for the three-month period of the survey was 62,000 tons, of which 45,000 tons were processed by firms mainly engaged in the automatic galvanizing of tubes. Of the 11 British firms, results for those galvanizing structural sections and windows each account for about 35 per cent of the total tonnage (for three months) of about 14,000. The remainder is too small a tonnage to provide a reliable guide to the activities of the industry.

Data given for the total annual throughput of 29 firms over a period of 12 years indicated that the most significant growth had occurred in firms dealing mainly with structural work. With the current emphasis on rust prevention and economic maintenance, it is suggested that the structural field appears to offer the best opportunities for expansion of the industry.

Plants processing relatively large tonnages (usually of structural work and windows) generally show the best fuel economy, while those processing bulky work such as tanks and holloware are the poorest in this respect.

In Great Britain only 5 out of 18 baths in the present survey were fired by solid fuel. On the Continent, however, the survey includes 16 oil, 17 gas and 5 solid fuel baths.

In British plants zinc losses (in dross and ash) are highest for baths operating the old dry process.

For all plants there seems to be little difference in the total amount of dross formed in wet and dry galvanizing.

Ash production is lowest in wet galvanizing practice, the average for all plants being 12·6 per cent compared with 16·3 per cent for the old dry process and 21 per cent for the dry process.

In general, mechanized plants, with their improved control, less acid and flux, particularly flux.

Opening session: The Burgomaster of Interlaken welcoming the delegates, with, seated, Mr. R. Gloor, Mr. Max Brodbeck, Mr. R. Lewis Stubbs, Mr. C. P. H. Wedge

this respect it appeared the dry process was better for sections, that for tubes, tanks and cylinders both processes had the same zinc losses, but that for holloware, windows and bolts and nuts the wet process offered distinct advantages.

He quoted some figures for his own plant in which there were three baths, of 225 tons capacity, working on the wet process. In the course of three months working the output of general galvanizing was 3,750 tons of which 45 per cent were sections, 29 per cent tubes and 25 per cent light tubes.

More details about one of the baths mentioned in the Paper were sought by **Mr. Ch. van Kempen** (Holland), who asked whether in this particular bath (No. 32) which was galvanizing nuts and bolts at a temperature over 500°C. a graphite or ceramic kettle was employed.

Dealing with developments in Germany **Mr. Kurt Lewus** said that the electrification of the German railways had created a demand for galvanized products which the industry was increasing capacity to serve. He illustrated the effect of shift working on fuel consumption by saying that if the oil consumption for three shifts was 30 kilogram, it would be 35 kilogram for two shift and 40-45 kilogram for one shift, in all cases using a properly designed bath with flux. Oil heating was being increasingly used, showing a 30 per cent lower cost than gas. Fuel cost was not, however, the only consideration to be taken into account. Costs could be much lessened by increasing the output of the bath. Comparing ash and dross production in wet and dry galvanizing he said that the total should not be more than 30 per cent made up of 10 per cent dross and 20 per cent ash in the wet process, the figures being reversed for the dry process.

Replying, **Mr. M. H. Davies** said that the data given in the Paper were not intended to establish the superiority of one process over the other. It should be remembered that the relative efficiency of the wet process was affected by the fact that no figures were given for flux skimmings.

Thick Galvanized Coatings

With **Mr. G. Piper** (Sweden) in the chair, two Papers "Coating Weights on Hot Galvanized Steel Angles in Relation to Time of Immersion", by B. J. Barmack and "The Production of Thick Galvanized Coatings", by E. C. Mantle were discussed in the second half of the first technical session.

The Papers were introduced by **Mr. E. M. Wilson** who acted as Rapporteur. In the course of his remarks Mr. Wilson said that "Interest centres mainly around the current demand for coatings with a long life without maintenance and although the zinc coat life could be greatly increased by painting before erection the cost of this additional treatment is not acceptable—even though it can be shown to be a long term economy.

"The factors affecting coating weights are:— Composition of steel; Surface condition; Temperature of galvanizing; Withdrawal speed.

"Although much is known about these factors, the production of coatings of the required thickness at the desired price has not yet been generally achieved.

"Both Papers open with references to the demands for heavier hot galvanized coatings for such applications as transmission towers or steelwork for railway electrification and the oil refining industry, where maintenance attention or painting are difficult to give after erection.

"Study of Barmack's Paper shows some of the practical difficulties arising from the variations in results obtained in apparently similar conditions; but whereas his Paper assembles facts relating to tests, he refrains from making recommendations. Mantle, however, offers what he considers to be a practical method of obtaining heavier coatings.

"Barmack's Paper covers tests made on 120 pieces of angle, each 3 ft. long (which is the minimum length stipulated in A.S.T.M. Specification A123). Forty pieces each of the three sizes of angle were degreased, rinsed, pickled, rinsed, fluxed and then dipped in the molten zinc. Four different times were selected for each size of angle and the resulting coating weights are shown in Table III.

"These weights are derived from magnetic-gauge readings. Table I shows that the composition of the steel is normal. Table II specifies the immersion times for each of the four sections.

"The graph at Fig. 1 shows clearly that all the coating weights obtained in the tests are well above the A.S.T.M. minimum of 2 oz/ft².

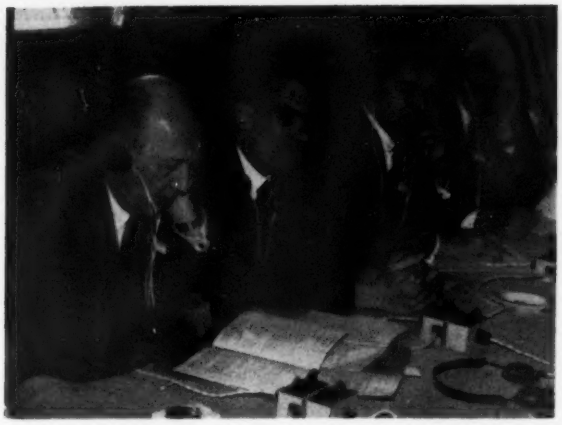
"I was surprised to find no reference to the speed of withdrawal.

"This, and also the angle of withdrawal, are most important factors and greatly influence the resulting coating thickness. (Neither does Mantle refer specifically to withdrawal speed in his Paper; but he points out in the footnote to his Table I that the angle of withdrawal influences the speed and therefore infers that speed is an important factor.)

"All Barmack's test pieces have been withdrawn vertically but it is seldom possible to withdraw long structural items in this manner and in any case its various component parts will be emerging from the bath at all manner of angles. Thus, with fabricated articles even though a constant hoist speed is used, withdrawal will occur at varying speeds for the different members, depending upon their angle relative to the bath surface. For instance, assuming 7 ft/min. vertical rate, a piece with a bracing at 45° will emerge at $7\sqrt{2}$ ft/min. and at 30°, $7\sqrt{3}$ ft/min. These higher speeds of withdrawal result in varying coating weights on the individual component parts of the fabricated structure and usually assist the galvanizer in meeting the customer's request for a coating in excess of $2\frac{1}{2}$ oz/ft².

"Table IV shows the variations in coating weight at top-end, centre and bottom-end of each size of angle tested and Barmack draws attention to the effect of section thickness on uniformity of weight of coating throughout the length of the angles.

"I would infer from his results that the angles were with-



Part of the audience at one of the technical sessions: Mr. C. R. Lyons, Mr. K. P. Scott, Dr. S. Radtke, Mr. S. W. K. Morgan

drawn from the bath at a speed higher than 10 ft/min. and if the speed had been, say 6 ft/min., much less variation between the points of measurement would have been observed.

"To check the Magne-Gage determinations quoted in Table III, a stripping test was made on random angles and the results which are recorded in Table V show reasonable agreement between the two methods.

"The author concludes with some observations on the effects of varying immersion periods from a minimum of $1\frac{1}{2}$ min. to a maximum of 12 min. which indicate that this is not a practical solution to the problem of how to obtain heavier uniform coatings commercially.

"Mantle's tests were all made on one section of angle, namely, $2\frac{1}{2} \times 2\frac{1}{2} \times \frac{5}{16}$ in.—they were also 3 ft. long and of commercial mild steel to B.S.15 which is a very wide specification.

"The pretreatment consisted only of immersion in inhibited hydrochloric acid and drying before dipping in molten zinc but the results shown in Table I are similar to those obtained by Barmack with the full pretreatment including prefluxing.

"Here you see the increased coating thickness due to withdrawal at 45° instead of vertically to which I have already referred.

"Mantle concludes from his tests that the required heavier coatings cannot be reliably obtained by the usual production methods and goes on to review the possible avenues of approach, namely:—

1. *Raising the galvanizing temperature.* As something in the order of 480°C. would be necessary he did not pursue this avenue.
2. *Using selected steels.* Silicon-containing steels are known to be used in several European countries and give the desired result but it is not a practical solution in the U.K. and Barmack has already stated that it is not acceptable in U.S.A. either.
3. *Entrapping more liquid zinc during withdrawal from the bath.* This is his practical answer and in Table II he shows the effect of various surface treatments on the thickness of coating obtained.

"For these tests the specimens were of steel sheet $3 \times 1\frac{1}{2} \times \frac{1}{10}$ in. thick with the hot rolled scale still on the surface. They were shotblasted using a ceramic nozzle taking about 20 ft³ air/min. at pressures up to 65 lb/in² and then either dipped through a zinc ammonium chloride flux layer on the bath or prefluxed and dried before dipping at 450°C. for 10 min. By varying the grade of shot, coating weights up to and in excess of 5 oz/ft² were obtained.

"Tables III and IV show the effect of varying shotblasting conditions but these specimens were only immersed for 5 min. instead of 10.

"Nozzle distance and rate of work travel had no appreciable effect on coating thickness provided, of course, that conditions were such as to clean the surface adequately.

"Reasonable rates of throughput—of the order of 20 ft²/hr/nozzle—are possible.

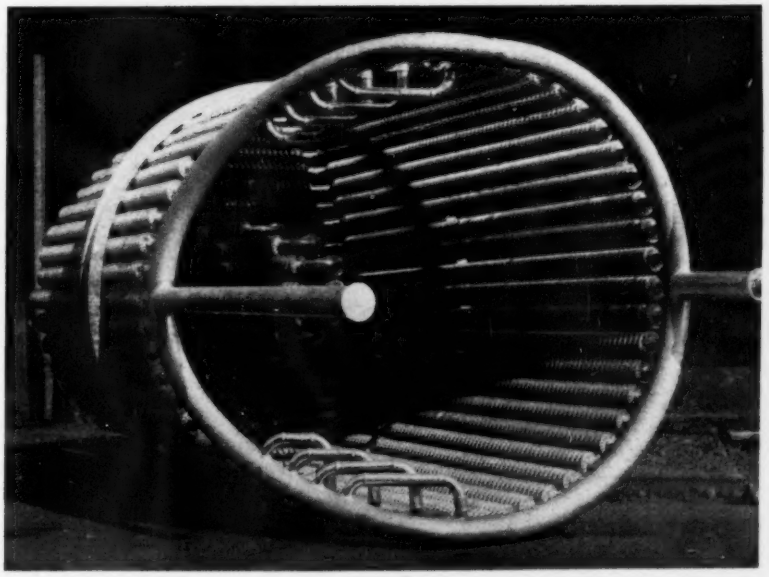
"Mantle's conclusions are that:— Shotblasting experiments indicate that roughening the steel surface by a suitable grade of abrasive provides an acceptable alternative to the use of an alloyed steel high in silicon where thicker than normal galvanized coatings are required. Laboratory experiments give some evidence that it might be possible to control the thickness of the coating obtained by varying the type of abrasive used, but this has yet to be confirmed by industrial trials. The coatings have some advantage over those produced on silicon-containing steels in that they resemble normal galvanized coatings in structure, having the usual outer layer of unalloyed zinc as distinct from the very thick layers of zinc-iron compounds present in the coatings produced on the silicon-containing steels.

"The main problem with shotblasting is that it would be difficult, if not impossible, to shotblast the inside surfaces of assembled box section structures. Shotblasting before assembly and then a light pickle as final pretreatment should be satisfactory in such cases.

"It would appear that suitable selection of grit will enable the required weight of coating to be applied to a specific steel within the range of 2 to 5 oz/ft²."

In the discussion which followed, **Mr. A. T. Baldwin** said that though minor in influence the fluidity of the zinc bath had some bearing on the thickness of the coating. He asked whether in Mantle's experiments the bath was pure zinc or whether aluminium additions were made. He foresaw difficulties in controlling shot blasting conditions.

Mr. R. Souske queried the withdrawal speeds of 10-20 ft/min. mentioned in Mantle's Paper and preferred 2-3 ft/min.



Cylindrical heat exchanger constructed from galvanized ribbed steam piping

Left—Mr. and Mrs. J. Wells, Mrs. H. C. Treglown, Mr. G. J. Phillips, Mr. H. C. Treglown

Below left—Mr. Max Brodbeck and Mr. A. T. Baldwin

Below right—Mr. S. W. Frost, Mr. R. H. Frost, Mr. C. P. H. Wedge and Mr. S. Frost

for the production of smooth surfaces. He also mentioned that thicker coatings could be obtained by longer times of immersion.

Mantle states, said **Mr. J. F. H. van Eijnsbergen,** that galvanizing pots will be attacked more rapidly when galvanizing temperatures are raised above 480°C. However, this remark applies more specifically to steel pots, whereas ceramic pots are nowadays often used when articles (e.g. nuts, bolts, etc.) are galvanized at 480-525°C. Several ceramic materials seem to possess an increased durability at such elevated galvanizing temperatures.

The greyish Zn/Fe-alloy coatings obtained on high silicon steels not only are less attractive in appearance but they tend also to develop a rust-coloured stain at its surface, which often is mistaken as a premature rusting. In our investigations of a number of such phenomena we never found any rusting of the steel base and even after several years of atmospheric exposure this stain does not cause any decrease in the layer thickness. However, the fact of an unsightly colour remains.

Whilst shotblasting might appear attractive as a means of increasing coating weights, this surface treatment may considerably increase finishing costs. In the Netherlands shotblasting by hand will cost hfl. 2·50-3·25 per m^2; in Wheelabrators the blasting of angles and sheets will cost hfl. 0·70-0·85 per m^2. Whilst Dutch experiences are parallel to those given by the author in Table II, there are several other variables in shotblasting to be considered, e.g. the distribution of particle sizes, the blasting angle, the air-speed and the mechanical properties of the shot-surface.

Additional information to that given in the Paper was provided by **Mr. E. C. Mantle** who said that industrial trials with galvanized shotblasted steel confirmed the results given in the Paper.

Thus, with steel angle $3 \times 3 \times \frac{1}{4}$ in., 30 in. long using the dry process at 450°C. with no aluminium but with the bath saturated with lead, the normal coating weight obtained with a withdrawal speed of $7\frac{1}{2}$ ft/min. was 2·2 oz/ft^2 for 2 min. immersion and 2·9 oz/ft^2 for 5 min. immersion. Shotblasted with a mixture of No. 16 and No. 40 grit the respective figures were 3·2 oz/ft^2 and 5·4 oz/ft^2, those with No. 16 grit alone being 2·8 oz/ft^2 and 5·0 oz/ft^2. Using a Wheelabrator and grit of the same size, coatings of 3·2 oz/ft^2 and 6·0 oz/ft^2 were obtained with immersion times of 2 min. and 5 min. respectively.

Answering **Mr. van Eijnsbergen,** he said that there was no evidence of ceramic pots being used in the United Kingdom though he thought they would be quite suitable for small articles.

With regard to costs, he thought that with large runs of structural steel, in a highly mechanized plant, these would be low enough to justify the increase in coating weight, particularly because from the customer's viewpoint, the parts would have longer life and there would be savings in maintenance.

In reply to a query by **Dr. D. Horstmann** he said they had made no records of surface roughness but that roughening improves surface adhesion. With regard to withdrawal speed, queried by Mr. Souske, the speed used was that current in industry. A lower rate, with its better drainage, would give thinner coatings. Not much was to be gained from immersion times larger than 5 min. except with the higher silicon content steels.

Mechanization in Galvanizing

Three Papers were discussed at the second technical session. They were "Mechanization in the Galvanizing Industry" by A. G. Northcott; "Mechanized Handling of Materials in Hot Dip Galvanizing Plants" by L. L. Boyles and W. M. Boyles and "A Note of the Emptying of Galvanizing Baths" by R. Gloor.

The chairman was **Mr. G. Brückner** (Austria) and the Papers were introduced by **Mr. Ch. van Kempen** (Holland). In the course of his remarks Mr. van Kempen said that the Paper by Gloor, though short, was strictly practical. He was particularly struck by the fact that the method of emptying the bath described did not interfere with the continuity of work on other kettles in the shop. Emptying, repair and replacement could be done in the shortest possible time. He thought that much valuable production time was lost when kettles had to be emptied by pumping out the zinc.

With reference to the Paper by L. L. and W. M. Boyles, he thought that it emphasized the fact that there was no magic formula for high production output. Output in U.S.A. plants was high because galvanizers there realized that there was no foolproof solution to all their problems. All the plants described, however, had one thing in common, namely, that a great deal of thought had been given as to how every movement, transport or handling could be done better, faster and cheaper. Quoting from the Paper:—

"One plant felt it was worth while to put small parts in burlap sacks at no cost to the customer—the savings in handling more than equalling the cost of the sacks."

"In one case a bridge crane was used to load a truck with 25 pieces of conduit, banded together to form one 15-ton bundle."

From the Paper it can be seen that no one type of crane is superior.

Quoting again:— "A large variety of racks was used, depending on the size and shape of the material to be galvanized." "The captive plants that processed large quantities of centrifuged work used differing arrangements." "Time cycles for these mechanical units covered a wide range." "Only at one of the galvanizing plants was a continuous overhead conveyor in use." This last quoted sentence shows that the conveyor is not the one and only solution to mechanization.

The Paper by Northcott can be summarized under three headings:

First, we have the "Essential preliminaries." Full mechanization cannot be applied or its great benefits realized until a much greater degree of specialization has been achieved. Greater specialization will only be made possible if integration of the industry precedes it.

Secondly, we have two important factors to consider with regard to the equipment, its selection and use, and its maintenance and replacement.

Thirdly, mechanization should never be introduced piecemeal; every introduction should form part of an overall plan. Expensive equipment must be selected on economical and technical considerations and must be used to the absolute maximum. Maintenance and replacement are of vital importance, the more costly the investment the more costly is every minute of standstill.

In the ensuing discussion **Mr. M. Puech** said that the problem of maintenance was of the greatest importance. Maintenance costs should be limited. At present they amounted to as much as 30-40 per cent of the cost price. Increased specialization, with accompanying improvements in mechanization would halve this cost.

He noted that in the Paper by Boyles, the kettles were divided into two categories: large (16 ft. and larger) and small (under 16 ft.). There was little reference to larger sizes in common use in Europe. Were larger baths in use in the U.S.A.?

One of the main problems of the galvanizing industry, said **Mr. E. M. Wilson,** is to find a material which is inert to the action of molten zinc. Where some degree of mechanization is employed the problem is further complicated by the need for such material to be resistant to attack by either hydrochloric acid or sulphuric acid and also zinc ammonium chloride flux. Nickel is reasonably satisfactory with zinc and hydrochloric acid; chromium may be all right with zinc and sulphuric acid but is too costly. Titanium, provided the immersion time in the zinc is of limited duration, is probably the best.

A trial carrier made of titanium had completed 3,650 cycles when it was withdrawn from service to be sent here for exhibition. The loss of weight of the titanium is negligible and provided the welding does not fail there seems to be no reason why the carrier should not complete a further 3,650 cycles before it requires to be replaced.

The relative costs of mild steel and titanium are shown in Table I.

Titanium has been compared with steel because this is what galvanizers normally use—we have actually been plating our steel carriers for about 10 years and have reduced the cost relative to unplated carriers by 33 per cent, the cost per 1,000 dips being £20.3.10.

TABLE I—RELATIVE COST OF TITANIUM AND MILD STEEL CARRIERS

	Titanium carrier	Steel carrier
Life	At least 7,500 dips (estimated)	650 dips
Zinc carry-over	Nil	0·316 lb. per dip 205 lb. on life
Hydrochloric acid consumed by carry-over	Nil	2·5 lb. per dip 1,625 lb. on life
Heat taken out by carrier	0·28 kWh. per dip 2,100 kWh on life	0·43 kWh per dip 280 kWh on life
Costs on life:		
Zinc at £90/ton	Nil	£ 8 5s. 0d.
Hydrochloric acid at £10 15s/ton	Nil	£ 7 16s. 0d.
Heat at 1d/kWh.	£ 8 15s. 0d.	£ 1 3s. 0d.
Carrier at May 1961 prices	£40 10s. 0d.	£ 3 16s. 0d.
	£49 5s. 0d.	£21 0s. 0d.
Total cost per 1,000 dips	£ 6 12s. 0d.	£32 6s. 0d.

It should be noted that our experience relates to the dry galvanizing process involving degrease, cold hydrochloric acid pickle, ammonium chloride liquid flux, followed by immersion in molten zinc, the maximum period of immersion being less than 3 min. Should the immersion period be consistently greater, say, averaging 10 min., the titanium might suffer some erosion as there is, with prolonged immersion, some point at which the molten zinc may have an appreciable effect upon the titanium.

Mechanization, said **Mr. F. Götzl,** was eminently suitable for wire galvanizing plants. For small parts a conveyor belt system was not satisfactory. Mechanization called for specialization by which means production could be increased, labour lessened and quality improved. Quenching separately was a definite advantage.

Mr. K. Lewus thought that the figures for wages given by Northcott (30-40 per cent) were too high. In Germany they were less than 10 per cent in non-mechanized plants.

Kettles 35-40 ft. long were in use in U.S.A. said **Mr. A. T. Baldwin** and there were a great many in use 27-35 ft. long. Widths ranged from 3-4 ft. wide and depths up to 8 ft.

All mechanization called for clean surfaces, remarked **Mr. O. Ruthner,** and he advocated the use of electrochemical cleaning.

In reply to Mr. Lewus, **Mr. A. G. Northcott** quoted the following cost figures for his own plant:— 39 per cent labour, 33 per cent material and 28 per cent overheads.

Mr. R. Gloor said that in his plant wages accounted for 30 per cent of the total cost.

(To be continued)

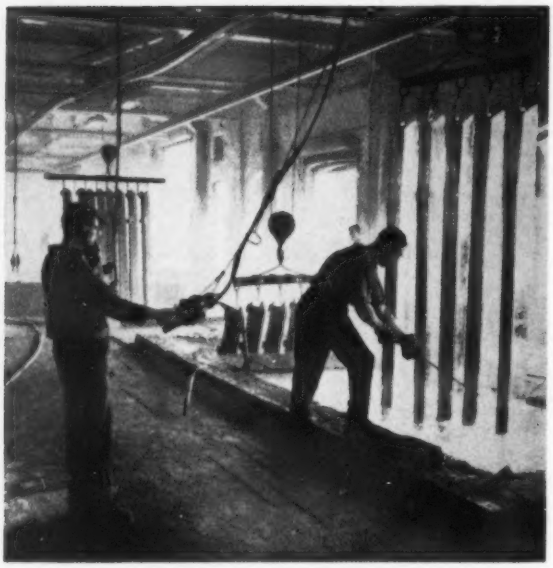
Some of the guests at the banquet given by the Swiss Galvanizers' Association at the Hotel Victoria Jungfrau

Mr. and Mrs. K. P. Scott

Mrs. R. Frost with Mr. and Mrs. E. G. Bayley

Works Visits

Verzinkerei Pratteln A.G.



Galvanizing heavy steelwork at the works of Verzinkerei Pratteln A.G.

WATER piping, gas piping, girders, angles and similar products form the greater part of the galvanizing work of Verzinkerei Pratteln A.G. In addition to the galvanized products, the company also produces water piping in polyethylene, and special tube fittings in polypropylene.

In the main galvanizing department, where the output per shift is some 10-12 tons of girders, 8-10 tons of gas piping, and 6-8 tons of steelwork, there are five galvanizing baths, handling a range of work from 370 cm. by 130 cm. by 260 cm. up to 2,200 cm. by 60 cm. by 10 cm. The total capacity of the five furnaces, in terms of molten zinc, is 230 tons.

Electric heating is used, the installed furnace load ranging from 75 to 480 kW, with a total load of 1,245 kW. In 1960 the current consumption reached 4,770,400 kWh, and the average cost was 19·94 francs/ton (approximately 33 shillings/ton).

With the type of bath installed, the life of the baths is 4-7 years for electrically-heated baths, and 1½-3 years if coal/oil heating is used.

Galvanized coatings in the main conform to the specification laid down by the Swiss Federal Railways, which calls for a minimum of 650 gm/m^2, representing a deposit 0·06-0·10 mm. thick (approximately 0·0025-0·004 in.).

Pickling is carried out in a plant with a volumetric capacity of some 20,000 L (4,400 gal.). There are 16 acid baths, of which 11 are of granite construction and five of wood; in addition, there are two Prodorite baths and an alkali bath.

For certain types of work, electrolytic baths are used, the sequence being: electrolytic galvanizing, rinse, Proseal I, rinse, Proseal II, rinse, hot rinse. In this process, both centrifuge- and immersion-type baths are used. The deposit is normally in the range 10-15 micron.

Some of the tube products of the company, i.e. black and galvanized gas pipes, and socket pipes up to 80 cm. inside diameter, have to be insulated, and, in a separate department, pipes up to 15·20 m. long are covered with bitumen and jute, glass matting, or asbestos and paper wrapping.

The plastics department produces a wide range of pipes for water supply, drainage, and for the chemical industry, as well as high and low pressure bottles for detergents, cosmetics and chemical products.

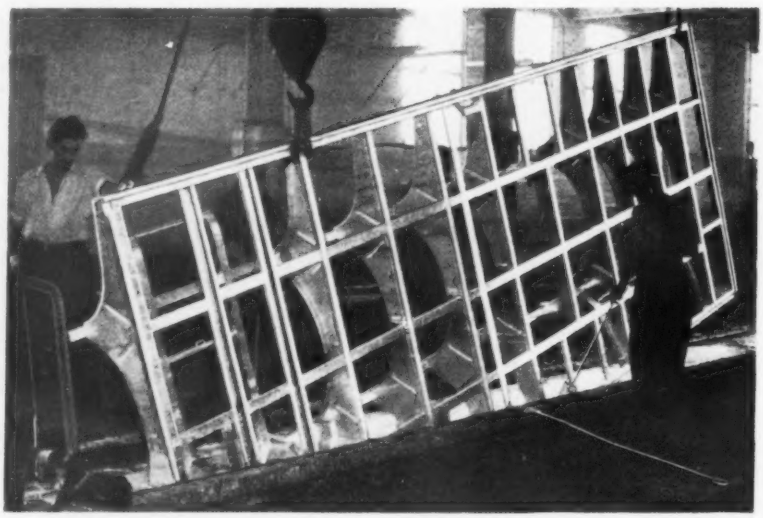
Kummler and Matter

FOUNDED in 1889 and formed into a joint stock company in 1909, the works of Kummler and Matter at Däniken is laid out for general galvanizing at a monthly production of 1,200-2,000 tons, depending on the type of material being treated. The works was transferred to Däniken from Aarau in 1933, and at one time the firm was the first Swiss plant in the galvanizing industry to use electric heating of the furnaces.

The actual number of employees and workmen (work at Zurich included) is 600.

The pretreatment, i.e. pickling of the work being galvanized, is carried out in special pickling tanks or stoves for

Truck frame, 20 ft. long, being galvanized at the works of Kummler and Matter



paint removal. A large pickling vat with a length of 72 ft., a width of 10 ft. and a depth of 5·5-6 ft. is installed. There is also a tunnel-furnace for paint removal with a length of 47·5 ft.

All galvanizing baths are electrically heated. Galvanizing of castings and small articles takes place in three baths.

A further two baths are used for the galvanizing of holloware, whereas bulky structures — such as window frames, big cylinders, etc.—are treated in a bath having a length of 13·5 ft., a depth of 8·9 ft. and a width of 5·3 ft. Two galvanizing baths, each having a length of 26 ft., are used for automatic galvanizing of tubes and mass-produced articles respectively. The longest galvanizing furnace, having a length of 67·5 ft., a width of 2·3 ft. and a depth of 3·75-4·3 ft., is used for the galvanizing of large structures.

Transport of material in the large storage yard, having a length of 660 ft., is managed by two cranes, a 5 ton travelling crane (span 151·5 ft.) and a rotary-tower crane serving an area of 132 ft. The works also has its own railway siding. There are two hydraulic straightening presses up to a pressure of 120 tons.

The zinc residuals formed by hot dip galvanizing are treated in the plant itself by the distillation process, which is carried out in two distillation furnaces. Zinc ash is treated and separated into zinc and zinc dust by a special separator. The waste acid is neutralized by a sewage purification plant and consequently only purified water leaves the works.

The following sections are also connected with the galvanizing works:—

A department for insulating every kind of pipes (up to a diameter of 23¾ in.) by means of bitumen and other wrappings. The plant is controlled electronically.

In the plating department, mainly very small articles are electroplated with zinc, nickel, cadmium and tin.

Further plants are used for tin and lead plating (hot dip) as well as for the manufacture of flat and round refrigerators of stainless steel for milk and other liquids. Bar grates are also manufactured.

A.F.L. Falck

PRODUCTION at the Arcore tube works of A.F.L. Falck began in 1953, although the rolling plants and finishing and services sections have been developed during the ensuing years. The zinc coating process was put into operation in 1954.

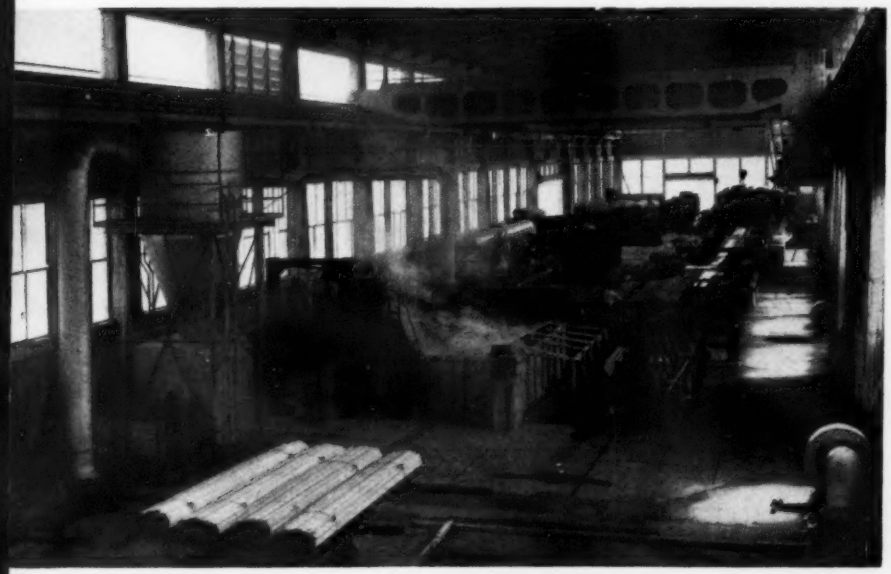
The plant was constructed according to the Aetna Standard Company's plan with only slight modifications of a functional character. The processing cycle is as follows:—Tubes from both the tube rolling mills and the tube welding machines are treated, passing first through pickling tanks; then follows washing and prefluxing. This is followed by hot dip galvanizing. The tubes are then blown externally and internally and allowed to cool.

The pickling process is carried out in four acid-resisting vats, two of which are fitted with mechanical agitators. For the prefluxing, a solution of zinc and NH_4 double salts is used. All vats are fitted with installations for the removal of acid fumes, which are washed in a water counter-flow system in special towers.

The zinc coating vat is made of Armco iron and is of 120 ton capacity, heated on both sides by methane, and is provided with adequate means of thermal control.

Tubes up to 114 mm. diameter are withdrawn from the vat by means of magnetic rollers, while for greater diameters a continuous chain extractor is used. Tubes are blown internally and externally with superheated steam from a special boiler. An adequate plant has been arranged for the extraction of ammoniacal fumes, steam and dust.

Hot dip galvanizing plant at the Milan works of A.F.L. Falck



G. Fischer A.G.

ORIGINATING in a mill near Schaffhausen in 1802, the Georg Fischer Aktiengesellschaft was formed into a company in 1896, and the concern now has a number of works in the area.

The range of production at the "GF" works covers tube fittings in malleable cast iron, both black and hot galvanized, solder joints and joints for copper tubes, joints of synthetic materials, and screw thread cutting machines for tubes, as well as other assembly aids. In addition, malleable iron castings of high quality for all types of application, grey iron castings and spheroidal graphite iron are also produced. Since 1945, the company has also operated a light alloy foundry where sand gravity and pressure die-casting are carried out.

In the galvanizing plant, which is a small subsidiary of the GF organization, production is directed mainly to the galvanizing of the malleable castings and tube fittings produced in the company's works. A certain amount of screw thread galvanizing is also carried out. Specialized equipment has been installed to make the process as nearly automatic as practicable.

Cornigliano S.p.a.

A MEMBER of the "Finsider" Group, the Cornigliano Company supplies some 15·8 per cent of the total Italian output of steel, and is the largest producer of flat steel products in southern Europe.

Galvanized sheets are produced in a continuous line (Sendzimir type) in which cold reduced sheets of Martin steel are coated with a zinc layer. There are also five hot-dip tinning lines and an electrolytic tinplate line for tinplate sheets. It is particularly to be noted that the continuous galvanizing line (Sendzimir type) and the electrolytic tinning line are the only ones installed in Italy.

The excellent adherence of the zinc to the base metal, made possible by the Sendzimir process, allows severe forming and drawing operations without peeling or flaking.

MEN and Metals

At the annual general meeting of the National Association of Non-Ferrous Scrap Metal Merchants, held in London last week, **Mr. A. G. Robinson,** of C. A. Robinson and Company (Greenwich) Limited, was elected President for the ensuing year.

Assistant production manager of Aberdare Cables Limited, **Mr. G. R. Bish,** M.Sc., A.I.M., A.C.S.M., has

been awarded first prize in the intermediate certificate in management studies at Glamorgan College of Technology. Mr. Bish's metallurgical training and metal fabrication experience in the electric cable industry have already been recognized by his appointment to a research committee of the British Non-Ferrous Metals Research Association. He is also a past Andrew Carnegie Research Silver Medallist in ferrous metallurgy.

Appointed deputy managing director of Stein and Atkinson Limited, **Mr.**

George Talbot is taking up his position this month.

Held at Melton Mowbray last week, the annual general meeting of the Production Engineering Research Association re-elected **Sir William Stanier,** F.R.S., as President for the ensuing year. **Sir Basil Tangye** was re-elected chairman of the council, **Mr. A. L. Stuchbery** and **Mr. G. R. Pryor** were re-elected vice-chairmen. Newly elected to the council of the association were **Mr. C. F. Barnard, Mr. C. G. H. Richardson, Mr. J. R. Widdowson** and **Mr. A. J. Worster.**

Chairman of the Morgan Crucible Company Limited, **Mr. Allen L. Stock** has been re-elected chairman of the London Chamber of Commerce.

At the first annual general meeting of the latest new branch, at Coventry, of the Institution of Works Managers, **Mr. N. H. Wilson,** of Sir W. G. Armstrong Whitworth Aircraft Limited, was elected chairman.

After 58 years' service with Harvey Frost and Company Ltd. and Ernest Lake Ltd., **Mr. J. R. Salmon** is retiring at the end of this month. He joined Harvey Frost in 1903.

It has been announced that **Mr. R. F. G. Lea,** deputy chairman and joint managing director of CIBA (A.R.L.) Limited has been appointed a director of CIBA Clayton Limited, Manchester.

News from the Anglo Metal Company Limited is that **Mr. J. O. Hitchcock** has been appointed to the board.

It is announced that **Mr. Harold Burke,** M.I.Mech.E., has been elected President of the Institution of Production Engineers for the year 1961-62. Mr. Burke is deputy chairman and joint managing director of Concentric Limited, and chairman and managing director of Concentric (Engineering) Limited, also chairman of Fletcher Bros. (Pressings) Limited. The Vice-President of the Institution for the ensuing year is **Mr. R. Ratcliffe,** C.B., M.B.E., M.I.Mech.E., controller of the Royal Ordnance Factories. **Mr. W. S. Horwood** has been appointed assistant education and technical officer to the Institution.

Director and works manager of Associated Electrical Industries (Manchester) Limited, **Mr. R. H. S. Turner,** M.A., has been re-elected for a second term of office as chairman of the council of the Institution of Production Engineers. **Mr. A. L. Stuchbery,** M.I.Mech.E., has been re-elected vice-chairman of the council. He is chief technical engineer of the Metal Box Company Limited.

An increase in their staff of technical sales engineers has been announced by Pye Process Heating. **Mr. R. P. Moore** will cover the area South of London and the Southern Counties. **Mr. R. Lapish** will cover the East Anglian area, including Stamford, Wellingborough and Stevenage; **Mr. J. J. Tyrrell** will continue in the North London area and High Wycombe, with **Mr. J. A. Taylor** covering South Wales to Birmingham as far as the Yorks. and Lancs. border.

First appointment announced by Attwood Technical Services Limited, the new British company formed to undertake economic research throughout the world, is that of **Mr. D. H. McNeile,** who joins as chief executive. Mr. McNeile has been with the United Kingdom Atomic Energy Authority for the past two years.

General manager of the D.P. Battery Company Limited, **Mr. N. L. Howell** has been appointed to the board of that company.

Joining the company 32 years ago as an office boy, **Mr. H. Clarke** has been appointed assistant managing director of Qualcast Limited, with effect from July 1 next.

Recent appointments by Leyland Motors Limited include the following: **Mr. C. S. Johnson,** B.Sc., manager of

the Farington foundry of the company for the last four years, has now been appointed chief metallurgist; **Mr. J. Ferguson,** foundry production

manager at the Farington foundry for the past two years, is to be foundry manager, and **Mr. L. J. Murray,** superintendent of the Farington engine factory, has been appointed works manager of Leyland's Chorley works.

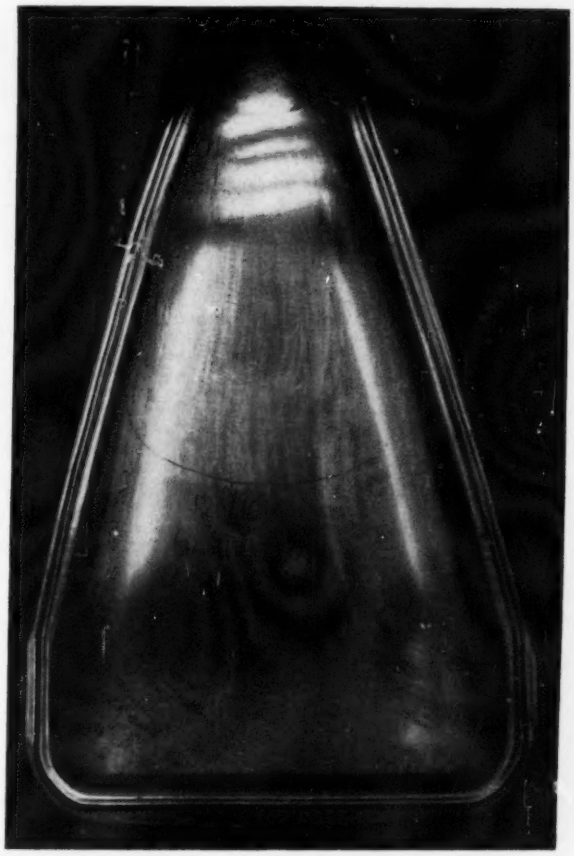
Appointed manager, group personnel services, Associated Electrical Industries (Rugby) Limited, **Mr. W. H. Taylor,** B.Sc., will be responsible for all personnel and associated matters, not only for the management company but for the Rugby-managed divisions and subsidiary companies of AEI.

Elected President of the Birmingham Junior Chamber of Commerce, **Mr. Stanley Wooldridge** is a director of Metal Sales Limited, a member of the Institute of Metals, and of the American Society for Metals.

It is reported that the **Rt. Hon. Lord Burden,** C.B.E., has retired from the boards of F. C. Larkinson Limited and Pinbrand Metals Limited.

Aluminium Alloys For Deep Drawing

By C. J. SMITH A.I.M.
(*Technical Director, Birmetals Ltd.*)
(*Continued from* METAL INDUSTRY, 16 *June* 1961)

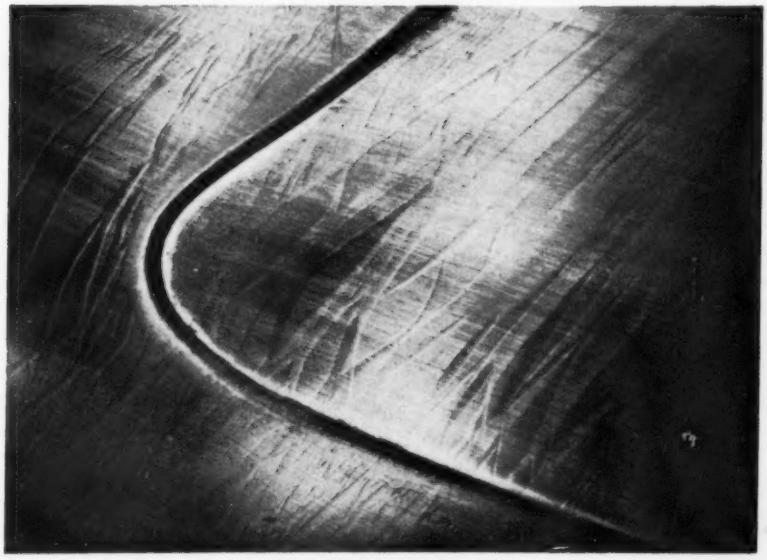


Right: Fig. 11—Stretcher-strain marks on Jaguar XK150 bonnet top pressing
Courtesy Pressed Steel Co. Ltd.

THE liability of mild steels to exhibit Lüders lines of stretcher-strain markings when lightly strained during drawing has been known for many years, and practices have been adjusted to avoid this phenomenon. One of the most generally adopted methods is to apply a light rolling reduction or skin pass of about 1 or 2 per cent to the soft sheet. Due to strain ageing, however, the beneficial effects are only temporary and for this reason it has become customary to apply light working by roller levelling in the press shop even to steel which had already been given a skin pass.

Similar markings have been encountered in the pressing of some aluminium alloys, notably those of the aluminium-magnesium group which have otherwise attractive properties and formability characteristics. As with ferrous materials, the markings are prone to occur in the lightly strained areas of shallow pressings such as are used for car door panels and the like. Typical examples of this defect on industrial pressings are shown in Figs. 11-13.

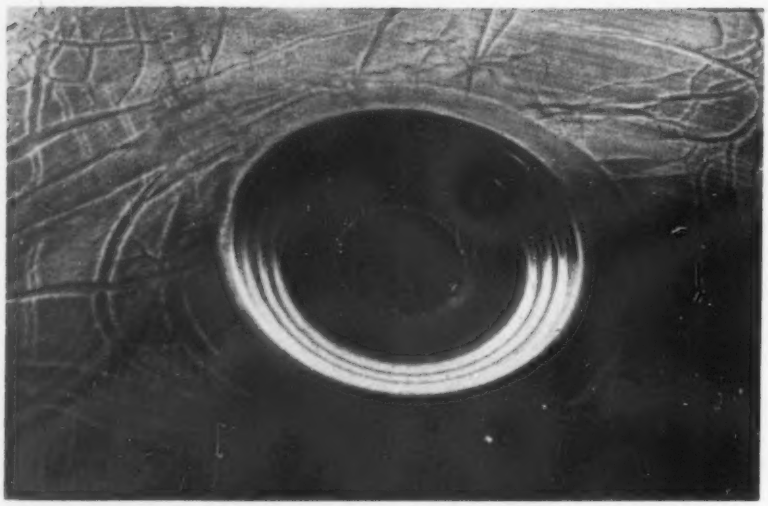
Fig. 12—Stretcher-strain markings on wing panel pressing



In both classes of material, the effect has been established as a manifestation of irregularities in the shape of the stress-strain curve and associated in particular with sudden large strains beyond the yield point (Fig. 14). This phenomenon has been closely observed in studies by a number of workers made a few years ago,[30,31,32] from which it was clearly established that in fine-grained annealed aluminium-3 per cent magnesium alloy sheet, two forms of markings are encountered: (a) random and flamboyant deep markings—sometimes referred to as wedge type markings; (b) very shallow but more uniform criss-cross parallel band markings.

The former occur at about 1 to 2 per cent extension and can exhibit differences in level of up to 0·003 in. At higher strains, these heavy markings disappear but are replaced by the latter shallow type, which may be no more than 0·0003 in. deep. These light markings appear as a criss-cross pattern of parallel bands at 45° to the stressing direction, and travel about the surface with progressively increasing strain. The two types of marking are depicted in Figs. 15 and 16.

It has been observed that, for such fine-grained material within a grain size range of 0·02-0·04 mm. average diameter the flamboyant markings dominate. With larger grain size, of the order of 0·05-0·06 mm., such



[*Courtesy: Pressed Steel Co. Ltd*

Fig. 13—Close-up of stretcher-strain markings on refrigerator evaporator door pressing

markings disappear entirely whilst the criss-cross type, which are now more evident at higher strains, are not normally regarded as troublesome in a pressing, as they are of minor dimension.

In material of even larger grain size, the flamboyant marking is still suppressed whilst the parallel band type remains, but the liability to "orange peel" surface increases.

It has thus been clearly established that only the random heavy markings are objectionable, and if these can be eliminated, the material can be employed with confidence.

The most widely accepted theory to explain the large yield point elongation in steels is one of locking of dislocations by the presence of "atmospheres" of solute atoms as proposed by Cottrell and Bilby.[33]

According to this theory, atoms of carbon and nitrogen in the steel occupy locking positions in the planes of dislocations and prevent normal steady slip taking place. Additional force is, therefore, necessary to tear the dislocations away from these solute atmospheres, but once this process has been initiated the force needed to continue its progress is appreciably reduced, thus giving rise to the sudden large yield.

Somewhat similar explanations have been proposed for aluminium alloys, but not in a completely satisfying manner. It is postulated that the magnesium atoms which occupy substitutional positions in the lattice form "atmospheres" rather as do carbon and nitrogen in steel, and lead to a locking of the progress of dislocations. The stress required to tear these apart is responsible for a sudden early yield as in the steels. The subsequently observed parallel type bands have been related to strain ageing effects, again on the basis of the behaviour of the magnesium atoms in interaction with dislocations. Explanations to account for the effects of grain size and the relative importance of the diffusion rate of magnesium atoms in promoting the strain ageing process do not appear to meet all objections. It is not opportune here to discuss this in detail but to suggest the subject may warrant further research if financial backing can be obtained. However, the practical answers to the problem have already been attained.

One method of control is obviously by adjustment of grain size as already described.

Work hardening processes such as temper rolling, which tear away the dislocations from the "solute atmospheres" are also beneficial, although the

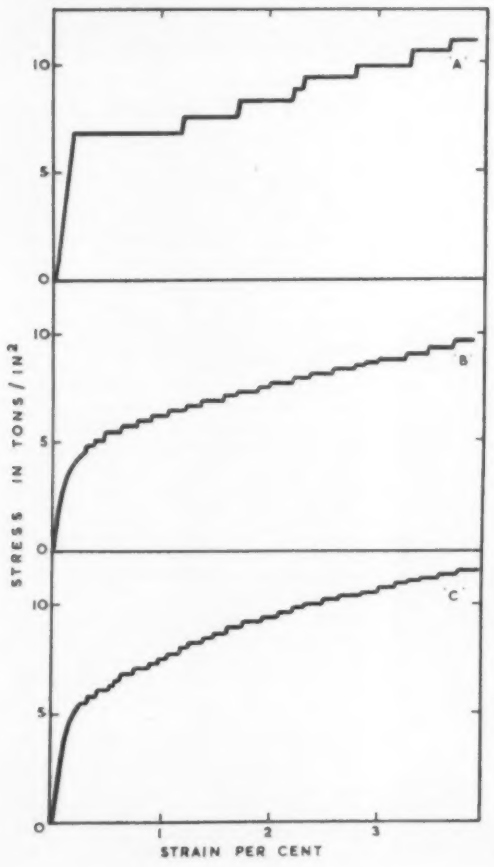


Fig. 14—Typical stress-strain curves for various materials

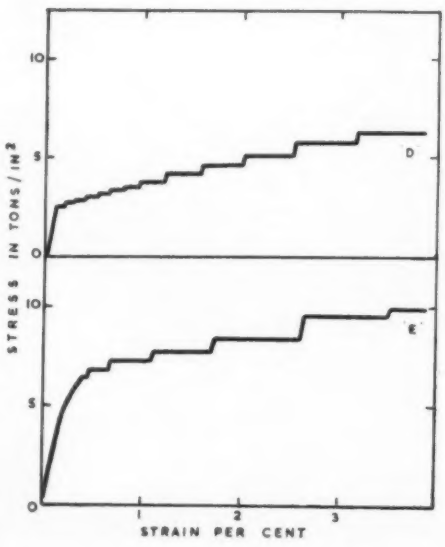
A—Annealed aluminium -3·5 per cent magnesium alloy; grain size 0·015 mm.

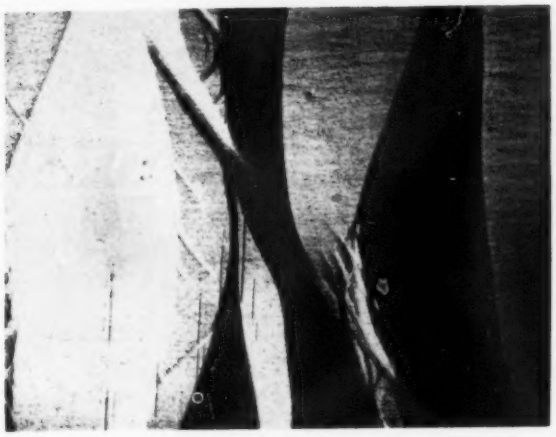
B—Annealed aluminium -3·5 per cent magnesium alloy; grain size 0·055 mm.

C—Aluminium-3·5 per cent magnesium alloy, salt bath annealed 525°C and water-quenched; grain size 0·030 mm.

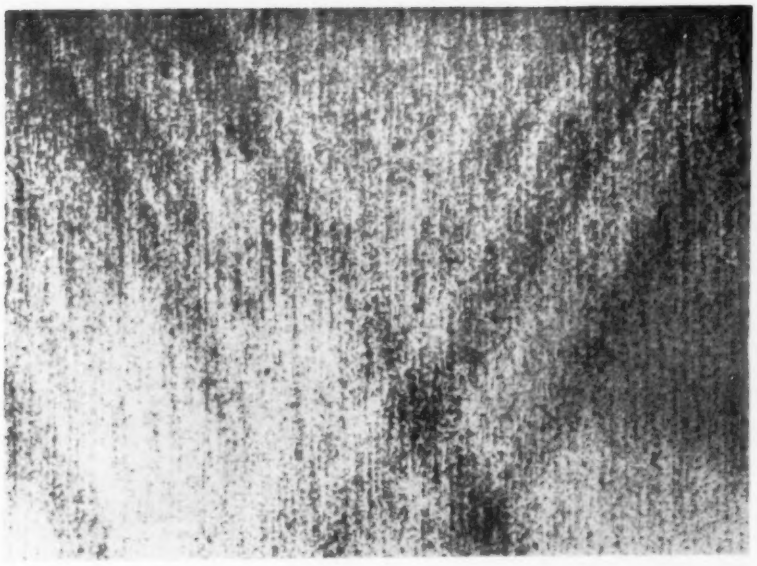
D—Annealed aluminium -1·25 per cent manganese alloy; grain size 0·035 mm.

E—Aluminium-magnesium-silicon alloy, solution treated; grain size 0·020 mm.





Left: Fig. 15—Wedge-type stretcher-strain markings [Courtesy: B.N.F.M.R.A.



Below: Fig. 16—Parallel-band type stretcher-strain markings
[Courtesy: B.N.F.M.R.A.

ductility of the sheet may be impaired even with quite light reductions and this will limit the use of this method in practice. Some relief can be obtained by using the partially annealed materials, which are also free from flamboyant markings provided the previous reduction has been sufficiently high and the partial anneal avoids temperatures approaching the recrystallization range.

Salt bath annealing at high temperatures, of the order of 500°C. upwards, has also been found suitable for avoiding stretcher-strain markings in this class of alloy. This is particularly effective if rapid heating of single sheets can be achieved and followed by water quenching; moreover, a fine grain size can be retained under these conditions, which is a decided practical advantage. The explanation of the effect of this treatment is believed to lie in the reduction of local solute concentrations.

In some instances, the markings can be suppressed by applying heavy roller levelling or by a light reduction of 5 per cent or so, followed by a non-recrystallization anneal, but this practice is not infallible, appearing to depend for its efficacy on the magnesium content, the grain size and the type of pressing.

Composition plays a significant part in controlling behaviour of this group of alloys. In general, the effect is more pronounced as the magnesium content increases, whilst silicon additions have a slightly beneficial effect, possibly because they tie up some of the magnesium atoms as Mg_2Si, which are not then available for diffusion. In a somewhat similar manner precipitation of aluminium - magnesium compounds in the higher magnesium alloys has been found to mitigate the effect.

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30 V. A. Phillips, A. J. Swain and R. Eborall; *J. Inst. Metals*, 1952/53, **81**, 625.

31 V. A. Phillips; *Sheet Metal Ind.*, 1953, **30**, 977, 1048.

32 R. Chadwick and W. H. L. Hooper; *J. Inst Metals*, 1951/52, **80** (1), 17.

33 A. H. Cottrell and B. A. Bilby; *Proc. Phys. Soc.*, 1949 (A), **62**, 40.

(To be concluded)

Readers' Digest

A.S.T.M. STANDARDS

"1960 Supplements to Book of A.S.T.M. Standards including Tentatives." *Published by American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa. Price $4.00 per part.*

PUBLISHED triennially, The Book of A.S.T.M. Standards is kept up to date in the intervening years by supplements issued to each of the 10 parts of the book.

In this year's supplements, Part 1, covering ferrous metals specifications, contains 444 pages and includes 63 standards on steel pipe, tubes, castings, bolting materials, boiler plates and rivets, sheet and strip, bars, forgings, chain, corrosion and heat-resisting steels. Also structural and rivet steel, coated steel and iron products, wrought iron, cast iron, ferro-alloys, titanium alloys, zinc-coated steel, metal powder products and steel rails.

Part 2, which deals with non-ferrous metals specifications and electronic materials, has 348 pages. This part includes 57 standards for copper and copper-base alloys, ingot, plate, sheet, strip, rolled bar, shapes, wire, die forgings, pipe and tubes. Also solder metal, zirconium, lithium, materials for electron tubes and semi-conductor devices, metal powders and electro-deposited metallic coatings. In addition, there are standards for die-cast metals, aluminium and aluminium alloys, magnesium and magnesium alloys, and metallic electrical conductors.

Methods of testing metals (except chemical analysis) are covered by Part 3 (180 pages), which includes 19 standards for tests for mechanical properties, effect of temperature, dosimetry, electrical and magnetic properties. Also included are non-destructive testing, metallographic tests, and tests for metal powders.

Magnesium in Galvanizing

AN improved process for hot-dip galvanizing has been developed at the Metal Cleaning Department of The Dow Chemical Company's Texas Division. Testing of the new process since 1955 at industrial-marine sites in environments aggressive enough to cause coating failure within six years has indicated that corrosion protection is improved 20 to 90 per cent when a slight amount of magnesium (0·04-0·05 wt. per cent) is added to the galvanizing bath.

The magnesium-containing coating produces a satin-white silver appearance but, as with coatings containing no magnesium, it is dependent on the amount of aluminium used in the bath. The most attractive coatings are obtained with a magnesium concentration of 0·03-0·05 per cent and an aluminium concentration of 0·003-0·004 per cent.

Industrial News — Home and Overseas

Theft of Metal

We have been advised by the National Association of Non-Ferrous Scrap Metal Merchants that the following categories of metal were stolen from a lorry in Bromley Road, London, N.1, at approximately 2.0 p.m. on June 14 last:

194 Gunmetal ingots, blue paint splashed on one end, weighing 1 ton 10 cwt. 2 qr. 8 lb.

64 Gunmetal ingots, red paint splashed on one end, weighing 10 cwt. 0 qr. 4 lb.

256 Phosphor bronze ingots, yellow and red paint splashed on one end, weighing 2 ton 0 cwt. 1 qr. 9 lb.

155 Aluminium alloy ingots, no markings, weighing 10 cwt. 3 qr. 24 lb.

The approximate value of this consignment is £1,200.

If any reader is able to give any assistance with regard to this theft, will they kindly communicate with the secretary of the association at Africa House, Kingsway, London, W.C.2. Telephone Holborn 8245/6.

U.K. Metal Stocks

Stocks of refined tin in London Metal Exchange official warehouses at the end of last week fell 644 tons to 8,090 tons, comprising London 3,905, Liverpool 3,041 and Hull 1,144.

Copper stocks rose 550 tons to 17,427 distributed as follows: London 600, Liverpool 14,252, Birmingham 50, Manchester 2,500 and Hull 25.

Lead duty-free stocks rose 475 tons to 8,075 tons, comprising London 7,746, Glasgow four and Swansea 325. In-bond stocks fell 25 tons to 3,768 tons, all in London.

Zinc duty-free stocks fell 420 tons to 4,556, comprising London 3,428, Glasgow 85, Manchester 450 and Liverpool 593. In-bond stocks fell 113 tons to 2,637 tons, all in London.

Loewy Engineering Deal

A contract to the value of approximately £1,250,000, covering the supply of Rolling Mill Equipment, has been signed in London by the **Loewy Engineering Company Limited,** a member of the T.I. Engineering Division, and DIA Maschinen-Export of the German Democratic Republic (East Germany).

Negotiations for this equipment, which consists of extensive installations for the hot and cold rolling of aluminium strip and foil, were initiated in March during the Leipzig Spring Fair, at which Loewy Engineering was exhibiting.

The equipment is intended for the East German non-ferrous metal industry and will be installed in factories in the Leipzig area.

Bi-Metal Thermometer

What is described as the first British bi-metal thermometer specially designed so that it can be re-calibrated without calling in a skilled technician, has recently been produced by the **British Rototherm Company Ltd.** Named the "Zero Re-set", this thermometer was originally planned for installations in countries where there is a high proportion of unskilled labour and where waiting for skilled men to re-set a thermometer can cause long delays.

The makers now anticipate that this instrument will be equally useful here where on occasions skilled technicians may not be readily available. The re-calibration procedure is said to be simple. At the lower back of the vertical head of the thermometer is a countersunk instrument screw stamped "RS-Re-set". After removing the screw, two turns of a 2 BA Allen key will loosen the locking screw and allow the thermometer stem to be rotated. This rotation moves the pointer and allows adjustments of up to 50 per cent of the scale range. A stop is incorporated in the locking device, which makes it impossible to damage the instrument.

At present available with 2½ in., 4 in. and 7 in. dials in the vertical pattern, in all standard temperature ranges, it is understood that horizontal patterns of this instrument will be available shortly.

Tube Products

A new series of data sheets describing their range of small-bore tubes and tube products has been produced by **Johnson, Matthey and Company Ltd.** Tubes to fine limits are available principally in non-ferrous metals and alloys, although grades of nickel-iron alloys are supplied, as well as tubes in precious metals for specialized applications.

The data sheets describe these tubes in terms of end uses, for example, Bourdon tube, capillary tube, restrictor tube, instrument pointer tube, tube for applications in electronics, and miscellaneous base-metal tubes. Sets of these sheets and further information are available from the company.

Change of Name

As a matter of convenience, Radio Heaters Ltd. have decided to change the name of the company to **Radyne Ltd.,** a name which has previously been used as the company's trade mark.

Interplas

On Wednesday last, at Olympia, London, the **International Plastics Exhibition and Convention** was opened by Lord Hailsham. The exhibition, which will continue until July 1, is organized by Iliffe Exhibitions Ltd., with the co-operation of the British Plastics Federation. Nearly 500 firms from thirteen countries have arranged displays.

Entrance to the exhibition is free for all bona fide visitors, provided they have tickets, which are obtainable from the organizers at Dorset House, Stamford Street, London, S.E.1.

News from Birmingham

More business has been booked in the second quarter of the year than in the first, and in the Midland area there are good prospects for the rest of the year. There is still capacity to produce more goods, but against this many employers are finding an acute shortage of skilled men. Many firms are well booked on metal components for the motor trade. The building boom also provided business for a variety of industries. The machine tool trade has shown marked improvement as compared with a year ago. Brassfounders maintain a high rate of activity.

In the iron and steel trade there is evidence that most products can now be obtained for early delivery, an indication that many producers have overtaken the arrears, and there is a better balance as between supply and demand. There is a strong demand for steel from the motor trade and the engineering industries. Many foundries are busy on castings for the motor trade. Structural engineers are heavily booked with rebuilding of shops, offices and commercial premises in Midland towns. The rolling programmes of steel mills have been extended so that a wider variety of sizes is available to customers promptly.

New Paint Stripper

A new, powerful, cold immersion paint stripper that, it is said, will quickly remove the most adherent paint films, including stoved epoxy resin acrylic, alkyd amino and polyurethene enamels by immersion and merely hosing, plunge rinsing or brushing off, has been developed by **Grant and West Ltd.**

Called "Chemiclene" No. 415, the stripper can be used in an ordinary mild steel tank, and it is supplied with its own inhibited, anti-corrosive water seal to prevent evaporation. A grade of the stripper is available which does not leave a residual smell on the metal treated.

Portable Hardness Tester

Details of a portable hardness tester which is being handled in this country by **Metallurgical Services (Planned Products (Metallurgy) Limited)** have just been released. This unit, which is of American origin, has a preloaded diamond indentor. To make a test, the hand grips are simply pressed towards the specimen. The movement of the indentor as it penetrates, compresses a diaphragm, hydraulically forcing fluid into a capillary tube.

The final position of the fluid indicates direct hardness value. Readings are based on the displacement of fluid. This instrument is portable and can be obtained in individual ranges corresponding to Rockwell A, B or C, Brinell 50-260 or 100-440 ranges.

Malayan Tin Shipments

Tin shipments from Penang in the first week of June amounted to 2,530 tons, according to the Straits Trading Company. They comprised U.K. 20, U.K. options nil, United States 770, the Continent 759, Canada 35, Japan 553, Pacific 19, India 145¼, South America 111, Africa nil, Australasia 107½ and the Middle East 9¾ tons.

Shipments from Singapore in the same period totalled 355¾ tons, comprising United States 50, the Continent 277, Pacific 3, India 4¾, South America 3, Africa 9¾, and the Middle East 8¼ tons.

Furnace Installation

An order for a bell-type furnace installation for the bright annealing of copper under vacuum conditions has been placed by Pirelli-General Ltd. with **The General Electric Company Limited.** The charge is to be in the form of wire and strip coils or wire on spools, and the rated output will be over 250 tons per week.

The installation will comprise four identical bell-type furnaces designed for

a maximum temperature of 500°C. Contrary to normal procedure, each furnace will be supported in a fixed elevated position, and the charge, carried on the furnace base, will be lifted up into the furnace. The furnaces, which will be about 7 ft. in diameter and 8 ft. high, will each be rated at 114 kW and will be provided with three individually-controlled heating zones.

Gas Cleaning Plant

An order has been placed with the Gas Cleaning Division of **W. C. Holmes and Company Limited** to supply gas cleaning plant for each of the first two electric arc furnaces to be installed at the Templeborough works of Steel Peech and Tozer. Each gas cleaning installation consists of a direct fume extraction system, an electrical precipitator and a common water treatment plant.

Sales Agreement

It has been announced that **Flexibox Limited** have concluded an agreement with **Alfred Herbert Limited** under the terms of which the latter company are appointed sole agents for the United Kingdom for the sale of the Flexibox range of lapping machines. The agreement came into force on June 1 last.

Flexibox lapping machines are used for the production of optically plane surfaces on parts made from almost any constructional material, including ferrous and non-ferrous metals, plastics, glass, carbon and semi-conductor crystals. The variety of applications is increasing almost daily as the potentialities of the machine lapping process for the production of high degrees of surface finish and flatness on engineering components is recognized.

Air Automation

Recently introduced by the Wolverhampton firm of **Air Automation** is a new ¼ in. bore air cylinder with rectangular section brass body and ⅛ in. B.S.P. ports. This is available in stroke lengths of ½ in. to 1½ in., and in single-acting, double-acting, and single-acting spring return models. This versatile little cylinder is provided with screwed nose mounting, and also with fixing holes through the body to provide for side or base mounting, and with provision for rear trunnion mounting, all as standard.

The piston rod is of stainless steel and the rod and piston seals are neoprene distributor type "U" seals, no "O" rings being used in the cylinder which is, therefore, capable of operating at fast speeds under light operating pressure and with a minimum of stiction. A midget flow control valve, No. A70M, is available for the speed control of these cylinders.

Blast Furnace Controls

Two sets of blast furnace controls for the new Spencer works of **Richard Thomas and Baldwins** at Llanwern, near Newport, Mon., are now being manufactured at the Bedford works of **Brookhirst Igranic,** a company in the Metal Industries Group. The order was placed by Ashmore, Benson Pease, the blast furnace specialists, of Stockton-on-Tees.

Each set of controls consists of five open type switchboards comprising: (a) ancillary board controlling incoming section and distribution to small drives; (b) charging board No. 1, with incoming section, alarm section and skip hoist; (c) charging board with stockline, distributor, breeze, water and coke controls; (d) charging board No. 3, handling weighing and vibro-feeders, material programme, bell sequence and pressure; and (e) D.C. distribution board.

In addition, a clay gun cubicle is being supplied for each furnace and a common stove ventilation panel to serve both sets at well as the necessary brakes, limit switches and pushbuttons.

Aluminium Sales

News from **Alcan Industries Ltd.** is that, as from July 1 next, their Luton sales office territory will take in Oxfordshire and the southern portions of Buckinghamshire and Essex hitherto covered by their London sales office.

The Luton office, at 57 Bute Street, previously a regional office, now becomes an area office and will be responsible for the counties of Bedfordshire, Cambridgeshire, Hertfordshire, Huntingdonshire, Norfolk, Northamptonshire, Soke of Peterborough, and Suffolk, in addition to those districts mentioned in the first paragraph. The office will remain under the managership of Mr. J. B. Rayner.

A.S.T.M. Publications

Availability of a 62-page list of publications is announced by the American Society for Testing Materials. Published in April of this year, this list of publications describes the symposiums, manuals, special publications, indexes, compilation of standards, charts, reference photographs and reports published by the society through the years. More than 300 items are fully described, 40 of which are new and not previously listed.

The publications cover all phases of materials and their evaluations and are arranged conveniently by titles and subject. A convenient order blank is bound into the catalogue. The list of publications may be obtained free for the asking from the society.

News from Paris

Speaking recently on the subject of the European Common Market, M. A. Dumas, Director General of the Aluminium Française, held out high hopes for aluminium inside the Common Market. He said that between 1950 and 1960 aluminium consumption had increased from 157,000 tons to 700,000 tons, which was a long way beyond the traditional theory that production doubled every ten years. Nevertheless, he thought that over the next ten years consumption would increase at the traditional rate and no faster. This would mean that by 1970 it would stand at a level of 1,400,000 tons.

He expected that by 1965 the Common Market countries would have passed the figure of 1,000,000 tons production per year. M. Dumas warned that it might be necessary to protect the Common Market from outside influence. That did not mean that all imports from outside the six should stop. Finally, M. Dumas said that modern production techniques would soon come into force and that before long these new techniques would show a considerable reduction in production costs.

A spokesman for the Haut Katanga Mining Union recently announced that a new automatic refining plant would soon come into production and that the annual production capacity of the Luilu plant

Scrap Metal Merchants

ON Wednesday of last week the annual general meeting and luncheon of the **National Association of Non-Ferrous Scrap Metal Merchants** was held at Grosvenor House, London, W.1. The annual general meeting, under the chairmanship of the retiring President, **Mr. H. G. Shields,** opened with the presentation of the President's report. Since the last half-yearly meeting, held in Birmingham last December, six Council meetings have been held, one of them in Birmingham and the others in London. The present membership of the association is 298.

A course of lectures has been arranged with the College of Advanced Technology in Birmingham, and will commence on October 11, continuing each Wednesday until December 13. Other matters mentioned in the report included the liberalization of the export of non-ferrous scrap metals, a choice of careers handbook, amendments to the existing aluminium specifications, and works visits.

Mr. A. G. Robinson

Following the acceptance of the financial statement for the year, the new President, **Mr. A. G. Robinson,** was installed. **Mr. Victor Brenner** has been elected Vice-President, and **Mr. M. C. Elton** as hon. treasurer. To fill the six vacancies on the Council the following members were elected: **Mr. C. H. Chick, Mr. M. C. Elton, Mr. G. B. Garnham, Mr. W. L. Nunn, Mr. Hugo A. McGhee,** and **Mr. H. N. Magnus.**

At the luncheon which followed, the chair was taken by the new President, Mr. A. G. Robinson. After the Loyal Toast had been honoured, the toast of "The Association" was proposed by **Mr. P. J. Smith,** chairman of the committee of the London Metal Exchange. Response was made by the President of the association. Mr. H. G. Shields, Immediate Past President of the association, proposed the toast of "Our Guests", and this was replied to by **Mr. J. A. Turpin,** Assistant Secretary of the Board of Trade.

It has been announced by the association that works visits have been arranged for October 11 next to British Insulated Callender's Cables Ltd., at Prescot, and Yorkshire Imperial Metals Ltd., at Kirby. Both parties are limited to 30 members.

would be increased to 100,000 tons of copper and 3,500 tons of cobalt. In 1960, total copper production was 300,704 tons and cobalt 8,204 tons. Further, the spokesman said that a further $50,000,000 would be invested in new installations in Luilu.

New Product

Introduction of a new product is announced by **Roto-Finish Limited.** This is "Grisiron G.42", being a water wash spray booth additive included in the range of Grisiron cleaners and chemicals. Used at a 2 per cent concentration, it is said that this new product is very economical.

New Spray Gun

An announcement from **Alfred Bullows and Sons Ltd.** concerns the introduction of a new spray gun and a completely new range of "FF" fine finishing nozzles for use with the Graco Airless "Hydra-Spray" equipment, for which they are sole U.K. distributors. Designed to increase efficiency and reduce operator fatigue, the spray gun is known as the Hydra-Spray "Golden" gun. It is a lightweight spray gun whose new rotary-action packing eliminates leaks. Very light trigger pressure gives an immediate, precise spray pattern and there is no "lag" to cause spitting.

The advantages provided by these new "FF" nozzles are that fine finishes can now be applied with feathered edges, thus enabling passes to be lapped; lower air pressure is required to operate the pressurizing pump than was previously necessary and, finally, the "FF" nozzles can apply thinner coatings. There are 17 "FF" nozzles, covering the complete range of fine finishing applications.

The gun is said to be equally efficient for high volume fine finishing or protective coating work, and the single hose enters the gun handle for improved balance; furthermore, coupling of the hose to the gun is by a special swivel attachment which gives the operator more freedom with less fatigue. A further feature is that the gun incorporates a tungsten carbide fluid valve and seat.

Malayan Tin

Malaya's tin production is gradually decreasing as rich ore-bearing lands are being worked out, a Department of Mines spokesman has warned. Annual production would drop further unless new deposits of tin are discovered. He said that more and more miners were now clamouring for new land to work and prospecting was in full swing. Faced with a grave shortage of land, a record number of miners applied for prospecting permits last year. A Government spokesman said 475 permits covering a total of 375,000 acres were issued. Most of these, he said, were for tin and iron prospecting. Although more permits were being issued now, very little tin had been found in new areas, the spokesman added.

At the end of April this year, there were 609 active mines, as against 738 mines at the end of December, 1957. Those which closed did so mainly because of land shortage. Over the past three years, Asian-owned mines recorded a drop of 28 per cent in production while the output of the European-owned mines had remained about the same.

Showing at ACHEMA

We understand from **Fleischmann (London) Ltd.** that their high vacuum department, which has, during the last few years, developed to an important branch of the firm, W. C. Heraeus GmbH, will be represented at the ACHEMA exposition with a particularly large programme. For the first time, one- and two-stage rotary high vacuum pumps with pumping speeds of 3-12 $m^3/hr.$, which have been developed during the last three years, will be shown. The manufacturing programme of the Heraeus high-vacuum Roots pumps, which up to now consisted only of types where pumps and motor form one vacuum-tight unit, was enlarged by a series of pumps with exteriorly connected motor. Due to this improvement, it is now possible to use this type of pump also for those applications which demand an explosion protection. The diffusion pump D 250 represents a novelty; i.e. pump and baffle are cooled by a cooling aggregate. This means that when using this pump for high-vacuum plants, a water connection is no longer needed, providing the advantage that such plants can also be operated in districts where water is scarce or where the quality of the water is not satisfactory.

A further novelty in the domain of producing high vacuum or ultra high vacuum is represented by two baffles. One baffle NW 100 with Peltier-cooling for temperatures ranging from $-20°$ $-30°C.$ is recommended for processes which only demand moderately low temperatures to produce and maintain the vacuum, but which, on the other hand, must be completely vibration proof. The dominant feature of the heatable Astrotorus-baffle NW 100 UHV is that all areas between pump and tank are equally maintained at a low temperature. Furthermore, to produce an ultra high vacuum, a new Ion-getter pump as well as an ultra cooling trap are employed.

Contract Secured

A member of the Metal Industries group, **Brookhirst Igranic,** have just received a major order for the new Vauxhall works at Liverpool. This is for electrical controls for a gas carburizing plant which is being supplied by British Furnaces Ltd.

Metal Statistics

Detailed figures of the consumption and output of non-ferrous metals for the month of April, 1961 have been issued by the British Bureau of Non-Ferrous Metal Statistics, as follows in long tons:—

COPPER	Gross Weight	Copper Content
Wire	21,300	20,880
Rods, bars and sections	14,758	9,680
Sheet, strip and plate	12,117	9,611
Tubes	7,458	6,873
Castings and miscellaneous	7,495	—
Sulphate	3,224	—
	66,352	53,976

Of which:

Consumption of Virgin Copper	39,636
Consumption of Copper and Alloy Scrap (Copper Content)	14,340

LEAD	
Cables	7,821
Batteries	2,604
Battery Oxides	2,912
Tetra Ethyl Lead	2,236
Other Oxides and Compounds	2,166
White Lead	703
Shot	424
Sheet and Pipe	6,018
Foil and Collapsible Tubes	344
Other Rolled and Extruded	487
Solder	1,419
Alloys	2,035
Miscellaneous Uses	1,636
Total	30,805

TIN	
Tinplate	733
Tinning:	
Copper Wire	48
Steel Wire	7
All other	70
Solder	153
Alloys	503
Foil and Collapsible Tubes, etc.	36
Tin Compounds, Salts, and Miscellaneous Uses	125
Total Consumption	1,675

ZINC	
Galvanising	7,837
Brass	9,192
Rolled Zinc	2,080
Zinc Oxide	2,066
Zinc Die-casting alloy	4,337
Zinc Dust	827
Miscellaneous Uses	932
Total, All Trades	27,271

Of which:

High purity 99·99 per cent	4,875
Electrolytic and high grade 99·95 per cent	4,129
Prime Western, G.O.B. and debased	11,233
Remelted	582
Scrap Brass and other Cu alloys	3,781
Scrap Zinc, alloys and residues	2,486

ANTIMONY	
Batteries	120
Other Antimonial Lead	43
Bearings	23
Oxides—for White Pigments	138
Oxides—other	69
Miscellaneous Uses	12
Sulphides	7
Total Consumption	412

Antimony in scrap	
For Antimonial Lead	565
For Other Uses	30
Total Consumption	595

CADMIUM	
Plating Anodes	45·35
Plating Salts	9·85
Alloys: Cadmium Copper	3·45
Alloys: Other	4·05
Batteries: Alkaline	4·50
Batteries: Dry	0·30
Solder	7·30
Colours	14·35
Miscellaneous Uses	2·30
Total Consumption	91·45

Metal Market News

TIN BUFFER STOCK EXHAUSTED — COPPER STILL WEAK — GENERAL DECLINE IN METAL STOCKS

TIN was the only metal last week to put up much of a show, for the others presented a somewhat depressing appearance. Copper weakened through lack of demand, and the May statistics, although on the whole not unfavourable, were not deemed to be particularly bullish even though there was a reduction in world stocks. The Copper Institute details are as follows, the particulars being shown in short tons of 2,000 lb. Inside the United States, output of crude copper was 117,208 tons against 106,611 tons in April, while the comparison in refined showed, rather surprisingly, an increase of about 20,500 tons at 148,961 tons. Deliveries to domestic consumers were 131,367 tons, rather more than 5,000 tons higher than in the previous months, while stocks of refined copper in producers' hands at the end of May were 7,265 tons down at 106,982 tons. Outside the United States, the production of crude copper was 200,243 tons against 202,013 tons in April, while the output of refined metal rose by rather less than 5,000 to 169,550 tons. Deliveries to the fabricators rose by about 10,000 tons to 209,046 tons, while stocks of refined copper fell by nearly 11,000 tons to 322,341 tons. The fact that stocks of refined copper dropped by about 18,000 tons on a world basis must certainly be accepted as a clear indication that curtailment of production is making itself felt, but the reserves are adequate and there is no real reason to suppose the existing cuts should be restored.

On the whole, the statistics for May must be acclaimed as favourable, but the market did not seem to be greatly impressed, and sentiment is rather bearish. While it is true that demand in the U.K. has declined, it is still on a good scale, and current reports from the States suggest that there has been an improvement there. All the more reason for surprise, therefore, that Comex has not been doing at all well and the price of copper scrap has declined. From the point of view of bull operators, the week began badly, for news came through that the troubles at Cerro de Pasco and Braden had been resolved. More than that, however, it became known that extreme action in the Kennecott dispute had been put off for a month or even longer, so that June 30 is no longer a deadline for a strike to begin. Quite a number of people are now beginning to think that the Corporation will succeed in resolving the differences existing with the unions so that, in fact, no strike will occur and this thought, it may be, is at any rate partially responsible for the weakness of the quotation last week.

Metal Exchange warehouse stocks were all reported lower last week, with the exception of copper, in which there was a rise of 350 tons to 16,877 tons. Of the others, tin registered a decline of 175 tons to 8,734 tons, while in lead the decline amounted to 225 tons, which brought the total down to 11,393 tons. Zinc stocks fell by 185 tons to 7,726 tons. Tin once again had quite an active week, for the turnover amounted to 2,410 tons, but on balance there was little change in the price, cash closing unaltered at £880 and three months 10s. up at £890. Trading in lead was very active, some 11,450 tons changing hands, but the quotations at £64 2s. 6d. and £65 7s. 6d. were unchanged on the week. Zinc lost ground on a turnover of 8,025 tons, cash closing £2 down at £77 15s. 0d., and three months £1 15s. 0d. lower at £78 15s. 0d. Dealing in standard copper was active, the turnover being 17,100 tons, both positions losing £6 10s. 0d. to close at £234 cash and £236 10s. 0d. three months. For the moment, confidence seems to have evaporated in this metal, and it remains for the quotation to decline to a level at which buyers are attracted by its cheapness.

Tuesday of this week saw the buffer stock of tin exhausted and in consequence of this prices advanced sharply.

New York

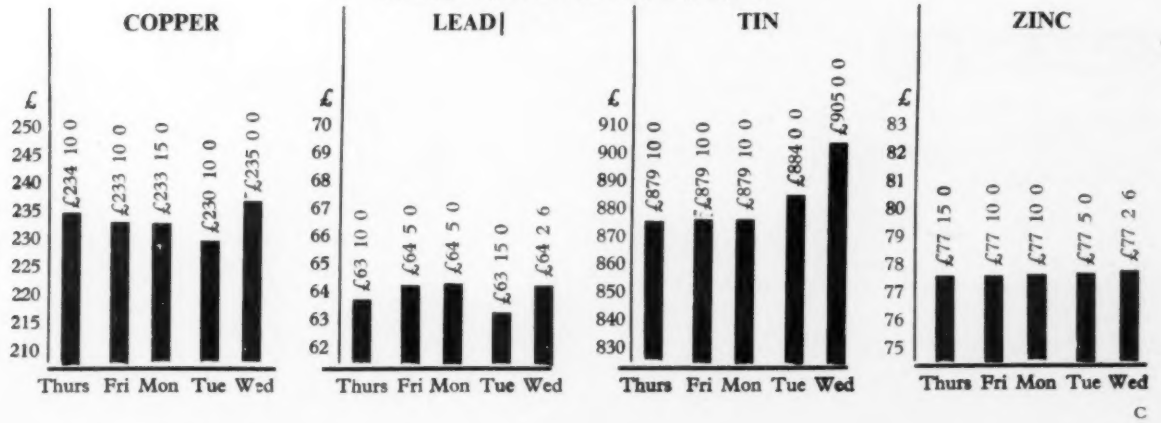
Copper futures were easy over the week-end on liquidation and stop loss selling. Dealings were active. Physical copper was quiet in the dealer sector. Light sales were reported to consumers at 30⅞ cents for immediate delivery. Custom smelters indicated continued satisfactory demand. Producer sales were fair. The scrap copper price was reduced by ⅛ cent by the high custom smelter, the bidder price becoming 26 to 26⅛ cents per lb. Tin was firmer but inactive. Lead and zinc were moderately active.

American smelting and refining company, whose silver output of 15,000,000 ounces annually accounts for about one-third of U.S. consumption, has said here that a silver shortage in about a year is possible. The company said the Treasury could sell at a higher rate rather than choose to restrict sales. Most users would find a modest increase more tolerable than shortages, it added.

A spokesman for the United Nations said last Friday that the U.N. Working Study Committee on Lead and Zinc closed its deliberations on June 12. He added that the Committee made no announcement of the result of its deliberations but would report back to a Standing Committee of the Study Group on Lead and Zinc. This Standing Committee, in turn, would then report back to the full Study Group. Well-informed trade sources said it was their belief that the obstacles to implementing a policy for lead and zinc price stabilization remained and little new developed from the meeting.

London Metal Exchange

Thursday 15 June to Wednesday 21 June, 1961



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NON-FERROUS

PRIMARY METALS

All prices quoted are those available at 2 p.m. 21/6/61

		£	s.	d.
Aluminium Ingots	ton	186	0	0
Antimony 99·6%	,,	237	10	0
Antimony Metal 99%	,,	230	0	0
Antimony Oxide				
Commercial	,,	194	10	0
Antimony White Oxide	,,	212	0	0
Arsenic	,,	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	,,		11	0
Calcium	,,	2	0	0
Cerium 99%	,,	15	0	0
Chromium	,,		6	11
Cobalt	,,		12	0
Columbite per unit			8	10	0
Copper H.C. Electro	ton	235	0	0
Fire Refined 99·70%	,,	234	0	0
Fire Refined 99·50%	,,	233	0	0

		£	s.	d.
Copper Sulphate	ton	79	10	0
Germanium	grm.		—	
Gold	oz.	12	11	2
Indium	,,		10	0
Iridium	,,	24	0	0
Lanthanum	grm.		15	0
Lead English	ton	64	2	6
Magnesium Ingots	lb.			
99·8%	,,		2	2½
99·9+%	,,		2	3
Notched Bar	,,		2	9½
Powder Grade 4	,,		5	6
Alloy Ingot, AZ91X		1	11¾-2	1¼
Manganese Metal	ton	280	0	0
Mercury	flask	67	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	,,		5	6
Osmium	oz.	20	0	0
Osmiridium	,,		—	

		£	s.	d.
Palladium	oz.	9	0	0
Platinum	,,	30	5	0
Rhodium	,,	46	0	0
Ruthenium	,,	16	0	0
Selenium	lb.	2	6	6
Silicon 98%	ton	123	0	0
Silver Spot Bars	oz.		6	7⅜
Tellurium Sticks	lb.	2	0	0
Tin	ton	905	0	0
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	,,		—	
Virgin Min 98%	,,	77	12	6
Dust 95/97%	,,	125	0	0
Dust 98/99%	,,	131	0	0
Granulated 99+%	,,	102	12	6
Granulated 99·99+%	,,	115	1	3

**Duty and Carriage to customers' works for buyers' account.*

INGOT METALS

All prices quoted are those available at 2 p.m. 21/6/61

Aluminium Alloy (Virgin)	£	s.	d.
B.S. 1490 L.M.5 ton	210	0	0
B.S. 1490 L.M.6 ,,	202	0	0
B.S. 1490 L.M.7 ,,	216	0	0
B.S. 1490 L.M.8 ,,	203	0	0
B.S. 1490 L.M.9 ,,	203	0	0
B.S. 1490 L.M.10 ,,	221	0	0
B.S. 1490 L.M.11 ,,	215	0	0
B.S. 1490 L.M.12 ,,	223	0	0
B.S. 1490 L.M.13 ,,	216	0	0
B.S. 1490 L.M.14 ,,	224	0	0
B.S. 1490 L.M.15 ,,	210	0	0
B.S. 1490 L.M.16 ,,	206	0	0
B.S. 1490 L.M.18 ,,	203	0	0
B.S. 1490 L.M.22 ,,	210	0	0
Aluminium Alloys (Secondary)			
B.S. 1490 L.M.1 ton	160	0	0
B.S. 1490 L.M.2 ,,	161	0	0
B.S. 1490 L.M.4 ,,	170	0	0
B.S. 1490 L.M.6 ,,	176	0	0
***Aluminium Bronze**			
BSS 1400 AB.1 ton	248	0	0
BSS 1400 AB.2 ,,	256	0	0

***Brass**	£	s.	d.
BSS 1400-B3 65/35 ton	178	0	0
BSS 249 ,,		—	
BSS 1400-B6 85/15 ,,	226	0	0
***Gunmetal**			
R.C.H. 3/4% ton ,,		—	
(85/5/5/5) LG2 ,,	221	0	0
(86/7/5/2) LG3 ,,	231	0	0
(88/10/2/1) ,,	288	0	0
(88/10/2/½) ,,	298	0	0
***Manganese Bronze**			
BSS 1400 HTB1 ,,	195	0	0
BSS 1400 HTB2 ,,	214	0	0
BSS 1400 HTB3 ,,	232	0	0
Nickel Silver			
Casting Quality 12% ,,	255	0	0
,, ,, 16% ,,	265	0	0
,, ,, 18% ,,	305	0	0
***Phosphor Bronze**			
B.S.1400P.B.1.(A.I.D. released) ,,	315	0	0
B.S. 1400 L.P.B.1 ,,	244	0	0

**Average prices for the last week-end.*

Phosphor Copper	£	s.	d.
10% ton	267	10	0
15% ,,	270	0	0
Phosphor Tin			
5% ,,	960	0	0
Silicon Bronze			
BSS 1400-SB1 ,,	285	0	0
Solder, soft, BSS 219			
Grade C Tinmans ,,	398	10	0
Grade D Plumbers ,,	317	0	0
Grade M ,,	439	5	0
Solder, Brazing, BSS 1845			
Type 8 (Granulated) lb.		—	
Type 9 ,, ,,		—	
Zinc Alloys			
BSS 1004 Alloy A ton	108	11	3
BSS 1004 Alloy B ,,	112	11	3
Sodium-Zinc lb.		2	6½

SCRAP METALS

Merchants' average buying prices delivered, per ton, 20/6/61

Aluminium	£
New Cuttings	135
Old Rolled	104
Segregated Turnings	78
Brass	
Cuttings	164
Rod Ends	147
Heavy Yellow	140
Light	135
Rolled	150
Collected Scrap	138
Turnings	140

Copper	£
Wire	211
Firebox, cut up	209
Heavy	208
Light	204
Cuttings	216
Turnings	190
Braziery	175
Gunmetal	
Gear Wheels	203
Admiralty	203
Commercial	188
Turnings	183

Lead	£
Scrap	55
Nickel	
Cuttings	—
Anodes	554
Phosphor Bronze	
Scrap	188
Turnings	183
Zinc	
Remelted	72
Cuttings	64
Old Zinc	43

METAL PRICES

SEMI-FABRICATED PRODUCTS

Prices vary according to dimensions and quantities. The following are the basis prices for certain specific products

		£ s. d.
Aluminium		
Sheet 10 S.W.G.	lb.	2 10½
Sheet 18 S.W.G.	,,	3 0½
Sheet 24 S.W.G.	,,	3 3½
Strip 10 S.W.G.	,,	2 10½
Strip 18 S.W.G.	,,	2 11½
Strip 24 S.W.G.	,,	3 1
Circles 22 S.W.G.	,,	3 4½
Circles 18 S.W.G.	,,	3 3½
Circles 12 S.W.G.	,,	3 2½
Plate as rolled	,,	2 10
Sections	,,	3 4
Wire 10 S.W.G.	,,	3 1½
Tubes 1 in. o.d. 16 S.W.G.	,,	4 4
Aluminium Alloys		
BS 1470. HS19W.		
Sheet 10 S.W.G.	,,	3 3
Sheet 18 S.W.G.	,,	3 5½
Sheet 24 S.W.G.	,,	4 1
Strip 10 S.W.G.	,,	3 3
Strip 18 S.W.G.	,,	3 4½
Strip 24 S.W.G.	,,	4 0½
BS1477. HP30M. Plate as rolled	,,	3 1
BS1470. HC15WP.		
Sheet 10 S.W.G.	,,	4 3
Sheet 18 S.W.G.	,,	4 8½
Sheet 24 S.W.G.	,,	5 8½
Strip 10 S.W.G.	,,	4 4
Strip 18 S.W.G.	,,	4 8½
Strip 24 S.W.G.	,,	5 4½

		£ s. d.
Aluminium Alloys—cont.		
BS1477. HPC15WP. Plate heat treated	lb.	3 10½
BS1475. HG19W. Wire 10 S.W.G.	,,	4 2
BS1471. HT19WP. Tubes 1 in. o.d. 16 S.W.G.	,,	5 5
BS1476. HE19WP. Sections	,,	3 4
Split tube		
19 S.W.G. (⅛″)	,,	4 2
20 S.W.G. (⅜″)	,,	3 11
21 S.W.G. (⅜″)	,,	4 1
22 S.W.G. (¼″)	,,	4 11
Welded tube 14 to 20 S.W.G. (sizes ½″ to 1½″)	,,	3/10½ to 5/8½
Brass		
Tubes	lb.	1 10⅜
Brazed Tubes	,,	3 3⅜
Drawn Strip Sections	,,	3 3⅜
Sheet	ton	202 10 0
Strip	,,	202 10 0
Extruded Bar	lb.	2 0⅜
Condenser Plate (Yellow Metal)	ton	192 0 0
Condenser Plate (Naval Brass)	,,	205 0 0
Wire	lb.	2 8½

		£ s. d.
Beryllium Copper		
Strip	lb.	1 4 11
Rod	,,	1 1 6
Wire	,,	1 4 9
Copper		
Tubes	lb.	2 4½
Sheet	ton	269 0 0
Strip	,,	269 0 0
H.C. Wire	,,	287 5 0
Cupro Nickel		
Tubes 70/30	lb.	3 7
Lead		
Pipes (London)	ton	107 0 0
Sheet (London)	,,	104 15 0
Tellurium Lead	,,	£6 extra
Nickel Silver		
Sheet and Strip 10%	lb.	3 11¾
Wire 10%	,,	4 4¾
Phosphor Bronze		
Wire	,,	4 2½
Titanium (1,000 lb. lots)		
Billet 4½″ to 18″ dia.	lb.	47/- 48/-
Rod ¼″ to 4″ dia.	,,	85/- 53/-
Wire ·036″–232″ dia.	,,	159/- 99/-
Strip ·001″ to ·048″	,,	350/- 68/-
Sheet 8′ × 2′. 20 gauge	,,	73/-
Tube, representative average gauge	,,	198/-
Extrusions	,,	90/-
Zinc		
Sheet	ton	115 5 0
Strip	,,	nom.

FOREIGN QUOTATIONS

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

Belgium	fr/kg	£/ton
Copper: electrolytic	33.75	246 13
Tin	122.00	891 13

Canada	c/lb	£/ton
Aluminium	26.00	210 12
Copper: electrolytic	30.00	243 0
Lead	10.00	81 0
Nickel	70.00	567 0
Zinc: Prime western	12.25	100 4
High grade 99.95	12.85	104 17
High grade 99.99	13.25	107 6

France	fr/kg	£/ton
Aluminium	2.43	179 11
Antimony 99·0	2.80	206 18
Cadmium	16.25	1,200 17
Copper: electrolytic	3.37	249 0
Lead	.97	71 13
Nickel	9.00	665 2
Tin	12.39	914 2
Zinc: Thermic	1.20	88 13
Zinc: electrolytic	1.28	94 11
Scrap		
Copper: electrolytic	2.92	215 14
Heavy copper	2.92	215 14
No. 1 copper wire	2.80	206 18
Brass rod ends	2.23	164 15
Zinc castings	.95	70 4
Lead	.88	65 0
Aluminium	1.70	125 12

Italy	lire/kg	£/ton
Aluminium	370	216 1
Antimony 99·0	520	303 13
Copper: wire bars 99.9	470	347 6
Lead	167	98 10
Nickel	1,180	689 2
Tin	1,620	956 1
Zinc: electrolytic	185	108 0
Scrap		
Aluminium soft sheet clippings (new)	305	178 2
Lead, soft, first quality	139	81 3
Lead, battery plates	79	46 2
Copper, first grade	395	230 13
Bronze, commercial gunmetal	350	204 8
Brass: heavy	285	166 8
Brass: light	270	157 12
Brass, bar turnings	285	166 8
Old zinc	108	63 0

Switzerland	fr/kg	£/ton
Aluminium	2.50	210 5
Copper: electrolytic	3.05	256 10
Lead	.85	71 9
Nickel	7.50	630 15
Tin	10.77	905 15
Zinc: High grade 99.99	1.10	92 10

Japan	Yen per metric ton
Scrap	
Copper: electrolytic	308,000
Copper wire No. 1	276,000
Copper wire No. 2	266,000
Heavy copper	273,000
Light copper	230,000
Brass, new cuttings	210,000
Red brass scrap	215,000

West Germany *Scrap*	D-marks per 100 kilos	£/ton
Used copper wire	235	214 1
Heavy copper	230	209 10
Light copper	205	186 15
Heavy brass	150	136 13
Light brass	120	109 6
Soft lead	58	52 16
Zinc	57	51 18
Used aluminium unsorted	90	81 19

United States	c/lb	£/ton
Aluminium	26.00	207 4
Antimony 99·0	32.50	259 0
Cadmium	160.00	1,275 4
Copper: electrolytic	31.00	247 10
Lead	11.00	87 13
Nickel	74.50	593 15
Tin	111.25	886 13
Zinc: electrolytic	25.50	98 12

THE STOCK EXCHANGE

All Round Weakness And Business Slow

ISSUED CAPITAL *	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 19 JUNE	+RISE—FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1961 HIGH	1961 LOW	1960 HIGH	1960 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	33/6	+1/-	11	9	6 11 3	33/9	26/3	35/-	26/6
400,000	2/-	Anri-Attrition Metal	1/3		NIL	4	NIL	1/3⅛	0/9	1/6	0/9
43,133,593	Stk. (£1)	Associated Electrical Industries ...	40/-	—1/6	15	15	7 10 0	54/10½	39/6	67/3	38/3
3,895,963	1	Birfield	60/-	—4/6	10	15‡	3 0 0	78/9	45/-	51/3	29/-
4,795,000	1	Birmid Industries	91/6	—9d.	20	20D	4 7 6	103/-	71/3	74/9	56/-
8,445,516	Stk. (10/-)	Birmingham Small Arms	25/6	—6d.	17½QT	12½	4 11 3	36/10½	24/9	30/6	18/3
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	14/6		5	5	6 18 0	14/6	13/9	17/4½	14/9
476,420	Stk. (£1)	Ditto Cum. B. Pref. 6%	17/-		6	6	7 1 3	17/6	16/9	20/-	17/1½
*300,000	1	Bolton (Thos.) & Sons Pref. 5% ...	16/6		5	5	6 1 3	16/6	13/9	16/-	14/3
1,500,000	Stk. (£1)	British Aluminium Co. Pref. 6% ...	17/-		6	6	7 1 3	18/-	16/6	21/1½	17/7½
18,846,647	Stk. (£1)	British Insulated Callender's Cables	59/6	—2/6	13½	13½	4 10 9	62/-	49/-	61/4½	47/-
20,456,599	5/-	British Oxygen Co. Ltd., Ord. ...	19/3	—2/-	16D	16	2 15 6	28/4½	17/6	35/-	19/10½
1,200,000	Stk. (5/-)	Canning (W.) & Co.	15/-	—6d.	15⅝	25+*2½C‡	5 5 3	20/9	13/7½	19/9	13/7½
60,484	1/-	Carr (Chas.)	1/-		NIL	12½	—	1/7½	10½d.	2/3	1/-
555,000	1	Clifford (Chas.) Ltd.	30/4½		12	10	7 18 0	30/4½	26/-	35/-	28/9
45,000	1	Ditto Cum. Pref. 6%	15/3		6	6	7 17 6	15/3	15/1½	16/-	15/10½
300,000	2/-	Coley Metals	3/9	—3d.	15	15	8 0 0	4/5½	3/6	5/-	3/4½
10,185,696	1	Cons. Zinc Corp.†	71/-	—1/-	20	15	5 12 9	81/6	64/-	80/9	59/6
5,399,056	1	Davy-Ashmore	158/9	—5/-	30‡	20	1 17 9	177/6	129/6	147/3	99/6
8,000,000	5/-	Delta Metal	22/9	—2/3	20	17½	4 8 0	27/7½	19/9	28/3	18/6
5,296,550	Stk. (£1)	Enfield Rolling Mills Ltd.	42/6	—6d.	15	15	7 1 3	52/3	42/6	56/9	45/-
1,155,000	1	Evered & Co.	45/6		10B	10φ	2 19 0	45/-	42/6	42/9	29/3
18,000,000	Stk. (£1)	General Electric Co.	33/9		10	10	5 18 6	39/6	29/6	47/9	29/-
1,500,000	Stk. (10/-)	General Refractories Ltd.	61/-	—1/-	25	20	4 2 0	65/-	42/9	52/6	40/-
937,500	5/-	Glacier Metal Co. Ltd.	19/-		15	13	3 19 0	21/1½	13/9	16/1½	11/1½
2,500,000	5/-	Glynwed Tubes	29/6	—9d.	22½	25¶	3 16 3	30/3	23/7½	27/6	17/-
7,228,065	10/-	Goodlass Wall & Lead Industries ...	34/3	—2/-	15	19L	4 7 6	44/9	34/3	41/9	33/-
696,780	10/-	Greenwood & Batley	25/-	—2/3	15	30‡	6 0 0	29/6	23/9Z	33/6	29/1½
792,000	5/-	Harrison (B'ham) Ord.	13/9	—6d.	*20‡	*17½	3 12 9	14/6	12/-	15/10½	11/9
150,000	1	Ditto Cum. Pref. 7%	19/9	—6d.	7	7	7 1 9	20/4½	19/9	23/6	22/-
1,612,750	5/-	Heenan Group	14/6		13	15	4 9 9	17/1½	10/6	13/-	9/10½
251,689,407	Stk. (£1)	Imperial Chemical Industries ...	69/3	—3/9	13½	11½	3 19 6	81/6	63/1½	76/6	54/-
34,736,773	Stk. (£1)	Ditto Cum. Pref. 5%	15/-	—6d.	5	5	£ 13 3	16/-	14/10½	18/-	15/4½
29,196,118	**	International Nickel	139½	—1	$1.60	$1.50	2 0 6	152½	104	105	84⅛
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	14/-		5	5	7 2 9	14/10½	13/6	16/6	14/6
6,000,000	1	Ditto Ord.	68/9	+8/-	12	12D	3 9 9	70/-	59/6	67/6	44/9
600,000	10/-	Keith, Blackman	20/-	—1/-	17½	17½E	8 15 0	21/6	18/3	32/6	17/6
320,000	4/-	London Aluminium	13/7½	—9d.	13	12	3 16 0	15/-	8/6	12/6	7/10½
765,012	1	McKechnie Bros. Ord.	64/9	—2/3	17½F	15F	5 8 0	68/-	53/6	71/6	57/3
1,530,024	1	Ditto A. Ord.	63/-	—3/6	17½F	15F	5 11 0	67/-	53/3	69/3	55/-
1,108,268	5/-	Manganese Bronze & Brass	16/-		20⅝	20⅝	6 10 0	18/6	14/-	18/6	13/4½
50,628	6/-	Ditto (7½% N.C. Pref.)	5/9		7½	7½	7 16 0	6/-	5/4½	6/6	5/9
26,361,444	Stk. (£1)	Metal Box	85/-	—1/6	12	12M	2 16 6	100/9	68/3	84/3	61/-
415,760	Stk. (2/-)	Metal Traders	7/6	—6d.	50	50	13 6 9	8/7½	6/9	10/9	7/1½
160,000	1	Mint (The) Birmingham	53/6	+1/-	15	12½	5 12 3	53/6	36/-	39/-	33/6
80,000	5	Ditto Pref. 6%	76/3		6	6	7 17 6	77/6	76/-	80/-	75/-
5,187,938	Stk. (£1)	Morgan Crucible A	61/6	—3/3	14	13	4 11 0	71/3	53/4½	63/-	47/6
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	16/-		5½	5½	6 17 6	17/-	15/3	18/9	15/9
3,850,000	Stk. (£1)	Murex	44/6	—3/-	22½J	15	5 15 0	52/-	39/9	45/-	35/3
585,000	5/-	Ratcliffs (Great Bridge) Ord. ...	16/-		10	10R	3 2 6	16/6	15/9	17/-	14/9
195,000	5/-	Ditto 8% Max. Ord.	5/-	+1½d.	8	—	8 0 0	5/1½	4/9	5/3	5/-
1,064,880	10/-	Sanderson Kayser	37/6	—6d.	17½	35‡	4 13 3	41/3	33/9	40/3	27/7½
3,400,500	Stk. (5/-)	Serck	17/7½	—1/-	12½	17½GD	3 13 9	19/3	15/-	25/6	15/3
8,035,372	Stk. (£1)	Stone-Platt Industries	56/-	—9d.	16	15	5 14 3	67/-	55/-	64/4½	52/3
2,928,963	Stk. (£1)	Ditto 5½% Cum. Pref.	15/6		5½	5½	7 2 0	18/-	15/-	18/7½	15/3
35,344,881	Stk. (£1)	Tube Investments Ord.	69/9	—1/9	14	20	4 0 3	85/6	69/6	140/3	63/10½
41,000,000	Stk. (£1)	Vickers	34/-	—1/-	10	10	5 17 9	38/3	28/-	39/7½	27/1½
750,000	Stk. (£1)	Ditto Pref 5%	14/6		5	5	6 18 0	15/-	12/7½	17/6	13/3
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	20/3	—3d.	*5	*5	7 7 0A	21/1½	19/9	24/6	20/1½
4,594,418	1	Ward (Thos. W.) Ord.	79/-	—3/3	13⅛	25	3 9 9	84/6	64/6	94/-	63/-
7,109,424	Stk. (£1)	Westinghouse Brake	43/3		11	10	5 1 9	46/3	36/4½	60/6	37/6
323,773	2/-	Wolverhampton Die-Casting ...	8/9	—9d.	35	30	8 0 0	13/4½	8/9	13/10½	8/1½
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156,930	2/6	Wright, Bindley & Gell	4/7½		15	20‡	8 2 3	4/9	3/7½	4/6	2/10½
124,140	1	Ditto Cum. Pref. 6%	13/-	—3d.	6	6	9 4 6	13/7½	13/-	15/-	13/6
150,000	1/-	Zinc Alloy Rust Proof	5/-	—1½d.	40	30	8 0 0	5/6	4/6	5/4½	4/-

*Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting. **Shares of no Par Value. ‡and 100% capitalized issue. ⊕ The figures given relate to the issue quoted in the third column. A Calculated on £7 8 9 gross. D and 50% capitalized issue. C paid out of Capital Profits. E and 50% capitalized issue in 7% 2nd Pref. Shares. R and 33⅓% capitalized issue in 8% Maximum Ordinary 5/- Stock Units. φ and 6½% from Capital Profits. B and 50% capitalized issue. G and 1½d. special distribution. F and special 5% tax free dividend. H As forecast. ¶And 3 for 7 capitalized issue. L and 33⅓% capitalized issue. M and 10% capitalized issue. J and 75% capitalized issue. S and 40% capitalized issue. O calculated at 13⅓%. Interim on smaller capital. P calculated at 11⅓% Q also 1/- special tax free dividend and 50% capitalized issue. T Per £1 unit. Z After capital reorganization. *The Thomas Bolton Ordinary Capital has been acquired by British Insulated Callender's Cables.

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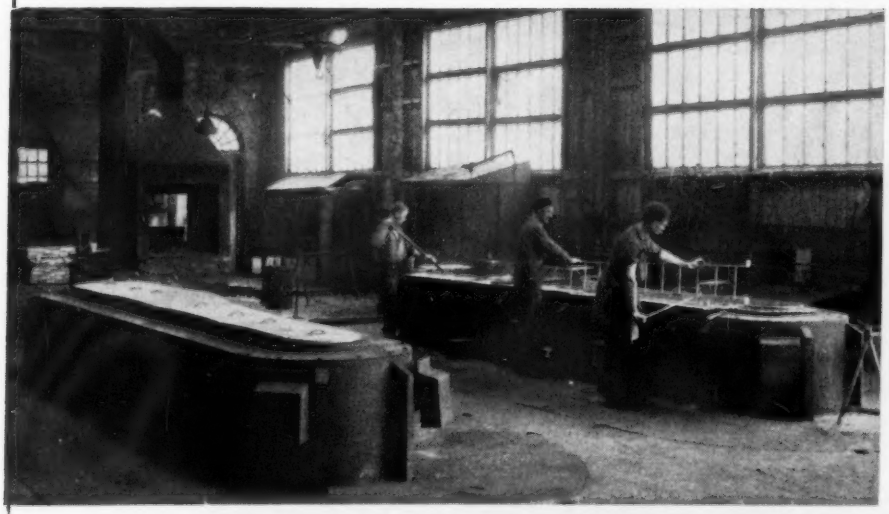

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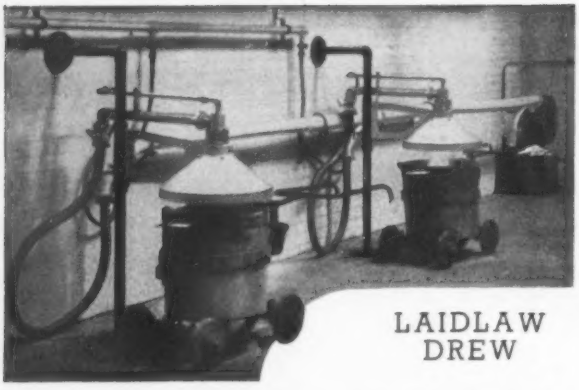

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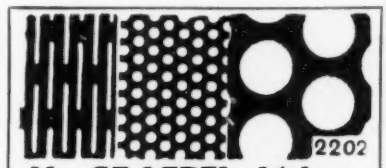

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